# Scientific and Technical Aerospace Reports

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National Aeronautics and Space Administration
**Langley Research Center**

**Scientific and Technical Information Program Office**

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*Scientific and Technical Aerospace Reports (STAR)* is an electronic abstract journal, listing citations with abstracts for aerospace-related reports obtained from worldwide sources. It is electronically published biweekly and announces documents that have recently been entered into the NASA Scientific and Technical Information (STI) Database. The documents are of the following types:

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- Translations in report form;
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- Other U.S. Government agency and foreign patents and patent applications
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*STAR* subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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# Table of Contents

## Subject Divisions

Document citations are grouped first by the following divisions. Select a division title to view the category-level Table of Contents.


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E. Geosciences
F. Life Sciences
G. Mathematical and Computer Sciences
H. Physics
I. Social and Information Sciences
J. Space Sciences
K. General


## Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for searching on *NASA Thesaurus* subject terms and personal author names.


Subject Term Index
Personal Author Index


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# Subject Categories of the Division A. Aeronautics

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## 01 Aeronautics (General) 1

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics see *categories 02 through 09*. For information related to space vehicles see *12 Astronautics*.

## 02 Aerodynamics 2

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery. For related information, see also *34 Fluid Mechanics and Heat Transfer.*

## 03 Air Transportation and Safety 8

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in *09 Research and Support Facilities (Air)*. Air traffic control is covered in *04 Aircraft Communications and Navigation*. For related information see also *16 Space Transportation and Safety*; and *85 Technology Utilization and Surface Transportation*.

## 04 Aircraft Communications and Navigation 12

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *06 Avionics and Aircraft Instrumentation*; *17 Space Communications; Spacecraft Communications, Command and Tracking*, and *32 Communications and Radar.*

## 05 Aircraft Design, Testing and Performance 15

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles, see *85 Technology Utilization and Surface Transportation*.

## 07 Aircraft Propulsion and Power 19

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

## 08 Aircraft Stability and Control 22

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also *05 Aircraft Design, Testing and Performance* and *06 Avionics and Aircraft Instrumentation*.

### 09 Research and Support Facilities (Air) 24

Includes airports, runways, hangers, and aircraft repair and overhaul facilities, wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operation see *03 Air Transportation and Safety.* For astronautical facilities see *14 Ground Support Systems and Facilities (Space).*

## Subject Categories of the Division B. Astronautics

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### 12 Astronautics (General) 24

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see *categories 13 through 20*. For extraterrestrial exploration, see *91 Lunar and Planetary Science and Exploration*.

### 13 Astrodynamics 26

Includes powered and free-flight trajectories; and orbital and launching dynamics.

### 14 Ground Support Systems and Facilities (Space) 26

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also *09 Research and Support Facilities (Air)*.

### 15 Launch Vehicles and Launch Operations 26

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.*

### 16 Space Transportation and Safety 29

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also *03 Air Transportation and Safety* and *15 Launch Vehicles and Launch Vehicles,* and *18 Spacecraft Design, Testing and Performance*. For space suits, see *54 Man/System Technology and Life Support*.

### 17 Space Communications, Spacecraft Communications, Command and Tracking 30

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information, see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

### 18 Spacecraft Design, Testing and Performance 30

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems, see *54 Man/System Technology and Life Support*. For related information, see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation and Safety.*

### 20 Spacecraft Propulsion and Power 32

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also *07 Aircraft Propulsion and Power; 28 Propellants and Fuels; 15 Launch Vehicles and Launch Operations;* and *44 Energy Production and Conversion*.


## Subject Categories of the Division C. Chemistry and Materials

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### 23 Chemistry and Materials (General) 40

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 24 through 29*. For astrochemistry see category *90 Astrophysics*.

### 24 Composite Materials 42

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

### 25 Inorganic, Organic, and Physical Chemistry 47

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also *34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics*.

### 26 Metals and Metallic Materials 56

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

### 27 Nonmetallic Materials 63

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

### 28 Propellants and Fuels 75

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft*

*Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion*.


### 29 Space Processing 92

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced–gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy.*


## Subject Categories of the Division D. Engineering

Select a category to view the collection of records cited. N.A. means no abstracts in that category.


### 31 Engineering (General) 93

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

### 32 Communications and Radar 97

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also *04 Aircraft Communications and Navigation;* and *17 Space Communications, Spacecraft Communications, Command and Tracking;* for search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation and Safety.*

### 33 Electronics and Electrical Engineering 107

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also *60 Computer Operations and Hardware;* and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar.*

### 34 Fluid Mechanics and Thermodynamics 113

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics.*

### 35 Instrumentation and Photography 125

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation;* and *19 Spacecraft Instrumentation*.

### 36 Lasers and Masers 132

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized

see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*.

**37 Mechanical Engineering 134**

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

**38 Quality Assurance and Reliability 137**

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

**39 Structural Mechanics 140**

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

## Subject Categories of the Division E. Geosciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

**42 Geosciences (General) 142**

Includes general research topics related to the Earth sciences, and the specific areas of petrology, minerology, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

**43 Earth Resources and Remote Sensing 147**

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see *35 Instrumentation and Photography.*

**44 Energy Production and Conversion 150**

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels*.

**45 Environment Pollution 162**

Includes atmospheric, water, soil, noise, and thermal pollution.

**46 Geophysics** **170**

Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology;* and *93 Space Radiation*.

**47 Meteorology and Climatology** **174**

Includes weather observation forecasting and modification.

**48 Oceanography** **182**

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

## Subject Categories of the Division F. Life Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

**51 Life Sciences (General)** **192**

Includes general research topics related to plant and animal biology (non–human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

**52 Aerospace Medicine** **210**

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

**53 Behavioral Sciences** **224**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**54 Man/System Technology and Life Support** **226**

Includes human factors engineering; bionics, man–machine, life support, space suits and protective clothing. For related information see also *16 Space Transportation* and *52 Aerospace Medicine*.

# Subject Categories of the Division G. Mathematical and Computer Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.


## 59 Mathematical and Computer Sciences (General) 231

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

## 60 Computer Operations and Hardware 233

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

## 61 Computer Programming and Software 235

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

## 62 Computer Systems 245

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

## 63 Cybernetics, Artificial Intelligence and Robotics 250

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also *54 Man/System Technology and Life Support.*

## 64 Numerical Analysis 253

Includes iteration, differential and difference equations, and numerical approximation.

## 65 Statistics and Probability 256

Includes data sampling and smoothing; Monte Carlo method; time series and analysis; and stochastic processes.

## 66 Systems Analysis and Operations Research 257

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

## 67 Theoretical Mathematics 259

Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.

# Subject Categories of the Division H. Physics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.


## 70 Physics (General) 260

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics*, *90 Astrophysics*, or *92 Solar Physics*.

## 71 Acoustics 279

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.* For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion Propulsion and Power.*

## 72 Atomic and Molecular Physics 283

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see *73 Nuclear Physics*.

## 73 Nuclear Physics 295

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

## 74 Optics 315

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## 75 Plasma Physics 323

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics*.

## 76 Solid-State Physics 338

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

## 77 Physics of Elementary Particles and Fields 349

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics, 73 Nuclear Physics, and 25 Inorganic, Organic and Physical Chemistry.*

# Subject Categories of the Division I. Social and Information Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.


**80 Social and Information Sciences (General) 355**

Includes general research topics related to sociology; educational programs and curricula.

**81 Administration and Management 355**

Includes management planning and research.

**82 Documentation and Information Science 357**

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software*.

**83 Economics and Cost Analysis 367**

Includes cost effectiveness studies.


# Subject Categories of the Division J. Space Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.


**89 Astronomy 367**

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x–ray, ultraviolet, and infrared astronomy; and astrometry.

**90 Astrophysics 370**

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

**91 Lunar and Planetary Science and Exploration 375**

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

**92 Solar Physics 378**

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

**93 Space Radiation 381**

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics*.

# Subject Categories of the Division K. General

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## 99 General 384

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

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# Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

*A Biweekly Publication of the National Aeronautics and Space Administration*

VOLUME 40, FEBRUARY 22, 2002

## 01
## AERONAUTICS (GENERAL)

*Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics see categories 02 through 09. For information related to space vehicles see 12 Astronautics.*

**20020016462** Sandia National Labs., Albuquerque, NM USA
**Solving Nonlinear Aeronautical Problems Using the Carleman Linearization Method**
Gaude, B. W.; Sep. 01, 2001; 66p; In English
Report No.(s): DE2001-787644; SAND2001-3064; No Copyright; Avail: Department of Energy Information Bridge

Many problems in aeronautics can be described in terms of nonlinear systems of equations. Carleman developed a technique to linearize such equations that could lead to analytical solutions of nonlinear problems. Nonlinear problems are difficult to solve in closed form and therefore the construction of such solutions is usually nontrivial. This research will apply the Carleman linearization technique to three model problems: a two-degree-of-freedom (2DOF) ballistic trajectory, Blasius' boundary layer, and Van der Pol's equation and evaluate how well the technique can adequately approximate the solutions of these ordinary differential equations.

NTIS
*Ballistic Trajectories; Nonlinear Systems; Problem Solving; Differential Equations*

**20020018881** NASA Glenn Research Center, Cleveland, OH USA
**HBCUs/OMUs Research Conference Agenda and Abstracts**
Dutta, Sunil, Compiler, NASA Glenn Research Center, USA; November 2001; 70p; In English; HBCUs/OMUs Research Conference, 17-18 Apr. 2001, Cleveland, OH, USA; Sponsored by NASA Glenn Research Center, USA; Also announced as 20020018882 through 20020018917
Contract(s)/Grant(s): RTOP 772-10-08-07
Report No.(s): NASA/TM-2001-211289; E-12765; NAS 1.15:211289; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche; Abstracts Only; Abstracts Only

The purpose of this Historically Black Colleges and Universities (HBCUs) Research Conference was to provide an opportunity for principal investigators and their students to present research progress reports. The abstracts included in this report indicate the range and quality of research topics such as aeropropulsion, space propulsion, space power, fluid dynamics, designs, structures and materials being funded through grants from Glenn Research Center to HBCUs. The conference generated extensive networking between students, principal investigators, Glenn technical monitors, and other Glenn researchers.

Author
*Aircraft Engines; Spacecraft Propulsion; Fluid Dynamics; Conferences; Abstracts*

**20020019555** Naval Postgraduate School, Monterey, CA USA
**Web-Based Information Management System for the Investigation, Reporting, and Analysis of Human Error in Naval Aviation Maintenance**
Boex, Anthony R.; Sep. 2001; 316p; In English; Original contains color images
Report No.(s): AD-A397001; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

The purpose of this thesis is to examine the development of a Web application to display, analyze, and produce reports of human error involvement and patterns in aviation maintenance mishaps. The Human Factors Analysis and Classification

System-Maintenance Extension (HFACS-ME) taxonomy, a framework for classifying and analyzing the presence of maintenance errors that lead to mishaps, is the foundation of this tool. The target audience for this tool includes safety and maintenance personnel, mishap investigators, and safety analysts. A review of five areas is needed to produce the Web-based prototype: (1) client/server architectures, (2) database management systems, (3) Web application design, (4) application coding, and (5) usability considerations for a Web/database tool. Collectively, these topics provided a foundation to develop an effective and user-friendly prototype, referred to as HFACS-ME Web. A usability study was conducted using potential end-users. The participants were given both written procedures to navigate through the prototype and an exit survey. The results of the survey, including objective and subjective responses, indicate strong user support for the HFACS-ME Web prototype in concept and implementation and suggest that the training and analysis capability it provides may contribute to a reduction in maintenance errors and ultimately a decreased mishap rate.
DTIC
*Management Information Systems; Aircraft Maintenance; Aircraft Accidents; Internets*

## 02
## AERODYNAMICS

*Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery. For related information, see also 34 Fluid Mechanics and Heat Transfer.*

**20020016155** Defence Science and Technology Organisation, Fishermans Bend, Australia
**Prediction of Buffet Loads on Twin Vertical Tails Using a Vortex Method**
Levinski, Oleg; Jul. 2001; 75p; In English; Original contains color images
Report No.(s): AD-A396754; DSTO-RR-0217; DODA-AR-011-966; X5-X5; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The work is concerned with the computation of F/A-18 vertical tail buffet due to LEX vortex burst using vortex methods of unsteady flow modelling. It is recognized that prediction of buffet loading requires accurate modelling of the unsteady pressure field past a burst LEX vortex. to reduce computational overheads associated with simulation of flow over the complete aircraft, a more generic delta-wing, twin vertical-tail configuration was used for initial studies. The aim is to generate an unsteady, vortex-breakdown flow using a delta wing and to place a vertical tail, which is cantilevered, downstream of the vortex breakdown flow. The paper describes the development of an unsteady vortex model for prediction of buffet loads and its validation against experimental data. Results of computation indicate that the vortex model is able to predict the onset of leading edge vortex breakdown and qualitatively describe the characteristics of unsteady buffet pressures arising on the rigid tail.
DTIC
*Vortices; Aerodynamic Characteristics; Loads (Forces); Tail Assemblies*

**20020016181** NASA Marshall Space Flight Center, Huntsville, AL USA
**An Approach to Establishing System Benefits for Technology in NASA's Hypersonics Investment Area**
Hueter, Uwe, NASA Marshall Space Flight Center, USA; Pannell, Bill, NASA Marshall Space Flight Center, USA; Aug. 17, 2001; 8p; In English; 52nd International Astronautical Congress, 1-5 Oct. 2001, Toulouse, France; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): IAF-01-V.4.05; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

NASA's has established long term goals for access-to-space. The third generation launch systems are to be fully reusable and operational around 2025. The goals for the third generation launch system are to significantly reduce cost and improve safety over current systems. The Advanced Space Transportation Program (ASTP) Office at the NASA's Marshall Space Flight Center in Huntsville, AL has the agency lead to develop space transportation technologies. Within ASTP, under the Hypersonics Investment Area, third generation technologies are being pursued. The Hypersonics Investment Area's primary objective is to mature vehicle technologies to enable substantial increases in the design and operating margins of third generation RLVs (current Space Shuttle is considered the first generation RLV) by incorporating advanced propulsion systems, materials, structures, thermal protection systems, power, and avionics technologies. The paper describes the system process, tools and concepts used to determine the technology benefits. Preliminary results will be presented along with the current technology investments that are being made by ASTP's Hypersonics Investment Area.

Author
*Hypersonics; Space Transportation; Technology Assessment; Space Shuttles; Propulsion System Performance; NASA Space Programs; Avionics*

**20020016210** Sandia National Labs., Albuquerque, NM USA
**Ribbon Surface Pressure and Wake Velocity Data for the Experimental Validation of a Vortex-Based Parachute Inflation Code**
McBride,; Clark,; Henfling,; Jun. 01, 2001; 112p; In English
Report No.(s): DE2001-783089; SAND2001-1631; No Copyright; Avail: Department of Energy Information Bridge

An experiment to measure surface pressure data on a series of three stainless steel simulated parachute ribbons was conducted. During the first phase of the test, unsteady pressure measurements were made on the windward and leeward sides of the ribbons to determine the statistical properties of the surface pressures. Particle Image Velocimetry (PIV) measurements were simultaneously made to establish the velocity field in the wake of the ribbons and its correlation with the pressure measurements. In the second phase of the test, steady-state pressure measurements were made to establish the pressure distributions. In the third phase, the stainless steel ribbons were replaced with nylon ribbons and PIV measurements were made in the wake. A detailed error analysis indicates that the accuracy of the pressure measurements was very good. However, an anomaly in the flow field caused the wake behind the stainless steel ribbons to establish itself in a stable manner on one side of the model. This same stability was not present for the nylon ribbon model although an average of the wake velocity data indicated an apparent 2 deg upwash in the wind tunnel flow field. Since flow angularity upstream of the model was not measured, the use of the data for code validation is not recommended without a second experiment to establish that upstream boundary condition.
NTIS
*Error Analysis; Flow Distribution; Ribbons; Wakes; Pressure Distribution*

**20020016464** Thermoscience Inst., Moffett Field, CA USA
**Experimental and Computational Study of Sonic and Supersonic Jet Plumes**
Venkatapathy, E., Thermoscience Inst., USA; Naughton, J. W., Thermoscience Inst., USA; Fletcher, D. G., Thermoscience Inst., USA; [1994]; 1p; In English; AIAA Atmospheric Flight Mechanics Conference, 7-9 Aug. 1995, Baltimore, MD, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS2-14031; RTOP 249-10-01; No Copyright; Avail: Issuing Activity; Abstract Only

Study of sonic and supersonic jet plumes are relevant to understanding such phenomenon as jet-noise, plume signatures, and rocket base-heating and radiation. Jet plumes are simple to simulate and yet, have complex flow structures such as Mach disks, triple points, shear-layers, barrel shocks, shock-shear-layer interaction, etc. Experimental and computational simulation of sonic and supersonic jet plumes have been performed for under- and over-expanded, axisymmetric plume conditions. The computational simulation compare very well with the experimental observations of schlieren pictures. Experimental data such as temperature measurements with hot-wire probes are yet to be measured and will be compared with computed values. Extensive analysis of the computational simulations presents a clear picture of how the complex flow structure develops and the conditions under which self-similar flow structures evolve. From the computations, the plume structure can be further classified into many sub-groups. In the proposed paper, detail results from the experimental and computational simulations for single, axisymmetric, under- and over-expanded, sonic and supersonic plumes will be compared and the fluid dynamic aspects of flow structures will be discussed.
Author
*Plumes; Supersonic Jet Flow; Numerical Analysis; Experimentation; Simulation; Noise Measurement*

**20020016486** NASA Ames Research Center, Moffett Field, CA USA
**Aerothermal Performance Envelopes for Hypersonic Small Radius Unswept Leading Edges and Nosetips**
Kolodziej, Paul, NASA Ames Research Center, USA; [1995]; 1p; In English
Contract(s)/Grant(s): RTOP 242-80-01; No Copyright; Avail: Issuing Activity; Abstract Only

Small radius leading edges and nosetips were utilized to minimize wave drag in early hypersonic vehicle concepts until further analysis demonstrated that extreme aerothermodynamic heating would cause severe ablation or blunting of the available thermal protection system materials. Recent studies indicate that diboride composite materials are shape stable under extreme aerothermodynamic heating at ultra high temperatures. Aerothermal performance envelopes for sharp components made from these materials are presented in this work to demonstrate the effects of convective blocking, surface catalycity, surface emissivity,

and rarefied flow effects on steady state operation at altitudes from sea level to 90 km. These components are capable of steady state operation at velocities up to 7.9 km/s at altitudes near 90 km.
Author
*Aerothermodynamics; Hypersonic Vehicles; Leading Edges; Nose Tips; Wave Drag*

**20020016710** Lockheed Martin Engineering and Sciences Co., Hampton, VA USA
**An Inviscid Computational Study of Three '07 Mars Lander Aeroshell Configurations Over a Mach Number Range of 2.3 to 4.5**
Prabhu, Ramadas K., Lockheed Martin Engineering and Sciences Co., USA; December 2001; 47p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-00135; RTOP 706-85-41-01
Report No.(s): NASA/CR-2001-211266; NAS 1.26:211266; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report documents the results of a study conducted to compute the inviscid longitudinal aerodynamic characteristics of three aeroshell configurations of the proposed '07 Mars lander. This was done in support of the activity to design a smart lander for the proposed '07 Mars mission. In addition to the three configurations with tabs designated as the shelf, the canted, and the Ames, the baseline configuration (without tab) was also studied. The unstructured grid inviscid CFD software FELISA was used, and the longitudinal aerodynamic characteristics of the four configurations were computed for Mach number of 2.3, 2.7, 3.5, and 4.5, and for an angle of attack range of -4 to 20 degrees. Wind tunnel tests had been conducted on scale models of these four configurations in the Unitary Plan Wind Tunnel, NASA Langley Research Center. Present computational results are compared with the data from these tests. Some differences are noticed between the two results, particularly at the lower Mach numbers. These differences are attributed to the pressures acting on the aft body. Most of the present computations were done on the forebody only. Additional computations were done on the full body (forebody and afterbody) for the baseline and the Shelf configurations. Results of some computations done (to simulate flight conditions) with the Mars gas option and with an effective gamma are also included.
Author
*Aerodynamic Characteristics; Aeroshells; Computational Fluid Dynamics; Inviscid Flow; Mach Number; Mars Missions; Wind Tunnel Tests*

**20020016863** NASA Langley Research Center, Hampton, VA USA
**Reynolds Number and Leading-Edge Bluntness Effects on a 65 Deg Delta Wing**
Luckring, J. M., NASA Langley Research Center, USA; [2002]; 18p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14 Jan. 2002, Reno, NV, Reno, NV, USA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2002-0419; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche
A 65 deg delta wing has been tested in the National Transonic Facility (NTF) at mean aerodynamic chord Reynolds numbers from 6 million to 120 million at subsonic and transonic speeds. The configuration incorporated systematic variation of the leading edge bluntness. The analysis for this paper is focused on the Reynolds number and bluntness effects at subsonic speeds (M = 0.4) from this data set. The results show significant effects of both these parameters on the onset and progression of leading-edge vortex separation.
Author
*Delta Wings; Blunt Leading Edges; Vortices; Wind Tunnel Tests; Reynolds Number*

**20020017577** NASA Langley Research Center, Hampton, VA USA
**Investigation of Reynolds Number Effects on a Generic Fighter Configuration in the National Transonic Facility**
Tomek, W. G., NASA Langley Research Center, USA; Hall, R. M., NASA Langley Research Center, USA; Wahls, R. A., NASA Langley Research Center, USA; Luckring, J. M., NASA Langley Research Center, USA; Owens, L. R., NASA Langley Research Center, USA; [2002]; 22p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2002-0418; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche
A wind tunnel test of a generic fighter configuration was tested in the National Transonic Facility through a cooperative agreement between NASA Langley Research Center and McDonnell Douglas. The primary purpose of the test was to assess Reynolds number scale effects on a thin-wing, fighter-type configuration up to full-scale flight conditions (that is, Reynolds numbers of the order of 60 million). The test included longitudinal and lateral/directional studies at subsonic and transonic conditions across a range of Reynolds numbers from that available in conventional wind tunnels to flight conditions. Results are

presented for three Mach numbers (0.6, 0.8, and 0.9) and three configurations: (1) Fuselage/Wing; (2) Fuselage/Wing/Centerline Vertical Tail/Horizontal Tail; and (3) Fuselage/Wing/Trailing-Edge Extension/Twin Vertical Tails. Reynolds number effects on the longitudinal aerodynamic characteristics are presented herein.
Author
*Aerodynamic Characteristics; Reynolds Number; Wind Tunnel Tests; Aerodynamic Configurations; Mach Number*

**20020017693** Instituto Nacional de Tecnica Aeroespacial, Madrid, Spain
**Computations of Transonic Flows for Wings by the Solution of the Unsteady Euler Equations (Euler-W)** ***Calculos de Flujos Transonicos Para Alas Mediante la Solucion de las Ecuaciones de Euler no Estacionarias (Euler-W)***
Varona, Jose Jimenez, Instituto Nacional de Tecnica Aeroespacial, Spain; July 2001; 42p; In English
Report No.(s): INTA-AT/TNO/4410/012/INTA/01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The last modification of a code wing analysis based on the unsteady Euler equations are shown in the present report. The grid generation procedure has been modified in order to have the possibility for studies of wings whose shape is not trapezoidal. The solutions have been compared to those from other codes, and the modifications have been validated.
Author
*Transonic Flow; Euler Equations of Motion; Wings; Computational Fluid Dynamics*

**20020018036** Duke Univ., Dept. of Mechanical Engineering and Materials Science, Durham, NC USA
**Limit Cycle Oscillations (LCO) and Nonlinear Aeroelastic Response: Reduced Order Models** ***Final Report, 1999 - 2001***
Dowell, Earl H., Duke Univ., USA; Nov. 01, 2001; 13p; In English
Contract(s)/Grant(s): F49620-97-1-0063; Air Force Proj. 2302
Report No.(s): AD-A396787; AFRL-SR-BL-TR-01-0598; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Unsteady aerodynamic computational models for aeroelastic phenomena such as flutter and limit cycle oscillations are complex and high dimensional. Under this grant, reduced order models are being developed that offer increased physical insight and greatly reduced computational cost. Transonic flows are emphasized because of their practical importance and significant technical challenge.
DTIC
*Aeroelasticity; Flutter; Transonic Flow; Unsteady Aerodynamics; Mathematical Models; Nonlinear Systems; Airfoil Oscillations*

**20020018614** Naval Postgraduate School, Monterey, CA USA
**Hi-Fidelity Simulation and Prediction of Helicopter Single Point External Load Stabilization**
Ehlers, George E.; Sep. 2001; 205p; In English
Report No.(s): AD-A397012; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
The helicopter has been used since its early development for external transport of large or bulky loads to small austere locations. Among the problems encountered as lift capability and airspeeds increased was that of divergent load oscillations due to load aerodynamics. The most problematic are the single point external loads displaying unsteady aerodynamics and coupled yaw-pendulum modes accounting for the instability of cargo containers. However, a lack of simulation models for unsteady aerodynamics renders simulation and analysis incapable of predicting the critical speeds at which such loads become unstable, This thesis attempts to provide a stabilization system for controlling the yaw degree of freedom for the single point external load, Empirical models of the yaw resistance at the hook and of the yaw moments due to vortex shedding were developed and tuned using flight test data and lab measurements Several load stabilization systems were considered, and a horizontal and vertical tail fin assembly was selected. This thesis presents simulation model improvements required for a simulation to match flight results for the load yaw, along with the design, modeling and optimization of the fin stabilization system, and a simulation assessment of the envelope expansion obtained from both passive and active stabilization.
DTIC
*Helicopters; Stabilization; Unsteady Aerodynamics; Critical Velocity*

**20020018828** Prins Maurits Lab. TNO, Rijswijk, Netherlands

**Verification and Improvement of Aerothermodynamic Heat Flow Estimation of a Re-Entering Ballistic Missile** ***Final Report Verificatie en Verbetering van Modellering ter Berekening van Aerothermodynamische Verhitting van een Herintredende Ballistische Raket***

Halswijk, W. H. C., Prins Maurits Lab. TNO, Netherlands; Bouquet, F., Prins Maurits Lab. TNO, Netherlands; August 2001; 82p; In English

Contract(s)/Grant(s): A00/KM/419; TNO Proj. 014.12113

Report No.(s): TD2001-0033; PML-2001-A33; Copyright; Avail: Issuing Activity

The Gulf War showed that defending an area against ballistic missiles is more complicated than expected because of unintentional break-up of some of the fired Scuds and almost all Al-Hussein missiles. Discriminating the missile's warhead from the other debris fragments was found to be a non-trivial problem for the Patriot ABM-system. The Royal Netherlands Navy (RNLN) is investigating the possibility to fit its new Air Defence and Command Frigate with a TBMD capability. The investigation will point out whether the ships radar systems, in combination with the Standard Missile 2, can provide this capability. For the RNLN the TNO-Prins Maurits Laboratory (TNO-PML) has investigated the break-up behavior of reentering ballistic missiles, identifying whether unintentional break-up can occur, what kind of debris fragments will be formed in that case and how they will descend. The investigation shows that unintentional break-up can indeed occur under specific circumstances. The investigation focused on the behaviour of the debris fragments after the moment of break-up and showed that in most cases, the warhead can be distinguished from the remaining fragments by its ballistic coefficient. Due to its high mass and favorable aerodynamic shape its deceleration in the lower regions of the atmosphere will be less than that of the other fragments, making it possible to discriminate the object by velocity measurements. The analyses have shown the sensitivity of the descent characteristics of the debris fragments to variations in initial conditions (launch conditions, type of warhead, etc.) and assumptions in the analysis models. Although absolute values vary, the observed trends in descent characteristics are maintained.
Author

*Aerothermodynamics; Debris; Fragments; Aerodynamic Heat Transfer; Computerized Simulation*

**20020019036** Lockheed Martin Engineering and Sciences Co., Hampton, VA USA

**Inviscid Flow Computations of the Shuttle Orbiter for Mach 10 and 15 and Angle of Attack 40 to 60 Degrees**

Prabhu, Ramadas K., Lockheed Martin Engineering and Sciences Co., USA; December 2001; 14p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS1-00135; RTOP 706-85-41-01

Report No.(s): NASA/CR-2001-211267; NAS 1.26:211267; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents the results of a computational study done to compute the inviscid longitudinal aerodynamic characteristics of the Space Shuttle Orbiter for Mach numbers 10 and 15 at angles of attack of 40, 50, 55, and 60 degrees. These computations were done to provide limited aerodynamic data in support of the Orbiter contingency abort task. The Orbiter had all the control surfaces in the undeflected position. The unstructured grid software FELISA was used for these computations with the equilibrium air option. Normal and axial force coefficients and pitching moment coefficients were computed. The hinge moment coefficients of the body flap and the inboard and outboard elevons were also computed. These results were compared with Orbiter Air Data Book (OADB) data and those computed using GASP. The comparison with the GASP results showed very good agreement in Cm and Ca at all the points. The computed axial force coefficients were smaller than those computed by GASP. There were noticeable differences between the present results and those in the OADB at angles of attack greater than 50 degrees.
Author

*Aerodynamic Characteristics; Aerodynamic Coefficients; Angle of Attack; Computational Fluid Dynamics; Hypersonic Speed; Inviscid Flow; Mach Number; Space Shuttle Orbiters*

**20020019227** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Transonic Drag Prediction Using an Unstructured Multigrid Solver**

Mavriplis, D. J., Institute for Computer Applications in Science and Engineering, USA; Levy, David W., Cessna Aircraft Co., USA; [2002]; 14p; In English; 40th AIAA Aerospace Sciences Meeting, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-0838; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper summarizes the results obtained with the NSU-3D unstructured multigrid solver for the AIAA Drag Prediction Workshop held in Anaheim, CA, June 2001. The test case for the workshop consists of a wing-body configuration at transonic flow conditions. Flow analyses for a complete test matrix of lift coefficient values and Mach numbers at a constant Reynolds number are performed, thus producing a set of drag polars and drag rise curves which are compared with experimental data.

Results were obtained independently by both authors using an identical baseline grid and different refined grids. Most cases were run in parallel on commodity cluster-type machines while the largest cases were run on an SGI Origin machine using 128 processors. The objective of this paper is to study the accuracy of the subject unstructured grid solver for predicting drag in the transonic cruise regime, to assess the efficiency of the method in terms of convergence, cpu time, and memory, and to determine the effects of grid resolution on this predictive ability and its computational efficiency. A good predictive ability is demonstrated over a wide range of conditions, although accuracy was found to degrade for cases at higher Mach numbers and lift values where increasing amounts of flow separation occur. The ability to rapidly compute large numbers of cases at varying flow conditions using an unstructured solver on inexpensive clusters of commodity computers is also demonstrated.
Author
*Aerodynamic Drag; Unstructured Grids (Mathematics); Computerized Simulation; Accuracy; Computational Fluid Dynamics*

**20020019802** Naval Postgraduate School, Monterey, CA USA
**Multi-Block Parallel Navier-Stokes Simulation of Unsteady Wind Tunnel and Ground Interference Effects**
Castro, Breno M.; Sep. 2001; 149p; In English
Report No.(s): AD-A397223; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A numerical investigation of unsteady wind tunnel and ground interference effects is carried out in the time domain to study the transonic flutter characteristics of the NLR 7301 section inside a wind tunnel and the thrust generation characteristics of a NACA 0014 airfoil plunging near a ground plane. A parallelized, multi-block, deforming grid, unsteady flow-solver is coupled with a two-degree-of-freedom structural model. For the transonic flutter problem, two types of porous-wall boundary-conditions are implemented and tested for the boundaries representing the tunnel walls. The type of porous boundary condition is found to influence significantly both steady and unsteady solutions. Results show that the free-flight flutter behavior may differ significantly from the behavior found in a porous wind tunnel because of the strong dependence on the tunnel porosity parameter and the proximity of the walls. An analysis of the trailing edge boundary condition is performed for the airfoil in ground effect. The computations show that this boundary condition influences the solution only when non-linearities are present in the flow-field, although parameters averaged through a cycle of oscillation are not affected significantly. The same behavior is observed for the influence of the turbulence model on the fully-turbulent, unsteady computations. However, the best agreement with low Reynolds number, experimental data is obtained when the flow is assumed laminar and no turbulence model is applied.
DTIC
*Navier-Stokes Equation; Unsteady Aerodynamics; Wind Tunnel Tests; Ground Effect (Aerodynamics); Computerized Simulation; Multiblock Grids; Turbulence Models*

**20020021276** National Aerospace Lab., Fluid Dynamics Div, Amsterdam, Netherlands
**Unsteady Leading Edge Suction Effects on Rotor-Stator Interaction Noise**
Schulten, J. B. H. M.; Feb. 12, 1999; 18p; In English; 5th AIAA/CEAS Aeroacoustics Conference, 10-12 May 1999, Washington, DC, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): PB2002-100826; NLR-TP-99064; AIAA Paper 99-1951; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A strictly linear analysis of the sound generated by an unleaned stator yields a vanishing amplitude for models with zero circumferential periodicity. In such a case higher order effect of stator leading edge suction on radiated sound is addressed. by a local analysis in the vicinity of the leading edge a suction force can be restored from the first order theory. This suction force oscillates at twice the frequency of the associated blade loading. Numerical examples show that the effect provides a realistic floor level for the sound that otherwise would seem to vanish. For non-zero circumferential modal wave numbers the effect can increase the acoustic intensity by as much as 10dB.
NTIS
*Leading Edges; Aircraft Noise; Unsteady Aerodynamics; Mathematical Models; Rotor Stator Interactions*

## 03
## AIR TRANSPORTATION AND SAFETY

*Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety; and 85 Technology Utilization and Surface Transportation.*

**20020017691** National Transportation Safety Board, Washington, DC USA
**Transportation Initial Decisions and Orders and Board Opinions and Orders Adopted and Issued During the Month of July 2000**
Jul. 2000; 266p; In English
Report No.(s): PB2000-916707; NTSB/IDBOO-00-07; No Copyright; Avail: National Technical Information Service (NTIS)
This publication contains all Judge Initial Decisions and Board Opinions and Orders in Safety and Seaman Enforcement Cases for July 2000.
NTIS
*Air Transportation; Decisions; Law (Jurisprudence); Aircraft Safety*

**20020017752** Georgia Inst. of Tech., School of Industrial and Systems Engineering, Atlanta, GA USA
**Techniques for Improving Pilot Recovery from System Failures** ***Final Report, 2 Mar. 1998 - 1 Mar. 2001***
Pritchett, Amy R., Georgia Inst. of Tech., USA; December 2001; 27p; In English
Contract(s)/Grant(s): NAG1-2014
Report No.(s): E-24-T42; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This project examined the application of intelligent cockpit systems to aid air transport pilots at the tasks of reacting to in-flight system failures and of planning and then following a safe four dimensional trajectory to the runway threshold during emergencies. Two studies were conducted. The first examined pilot performance with a prototype awareness/alerting system in reacting to on-board system failures. In a full-motion, high-fidelity simulator, Army helicopter pilots were asked to fly a mission during which, without warning or briefing, 14 different failures were triggered at random times. Results suggest that the amount of information pilots require from such diagnostic systems is strongly dependent on their training; for failures they are commonly trained to react to with a procedural response, they needed only an indication of which failure to follow, while for 'un-trained' failures, they benefited from more intelligent and informative systems. Pilots were also found to over-rely on the system in conditions were it provided false or mis-leading information. In the second study, a proof-of-concept system was designed suitable for helping pilots replan their flights in emergency situations for quick, safe trajectory generation. This system is described in this report, including: the use of embedded fast-time simulation to predict the trajectory defined by a series of discrete actions; the models of aircraft and pilot dynamics required by the system; and the pilot interface. Then, results of a flight simulator evaluation with airline pilots are detailed. In 6 of 72 simulator runs, pilots were not able to establish a stable flight path on localizer and glideslope, suggesting a need for cockpit aids. However, results also suggest that, to be operationally feasible, such an aid must be capable of suggesting safe trajectories to the pilot; an aid that only verified plans entered by the pilot was found to have significantly detrimental effects on performance and pilot workload. Results also highlight that the trajectories suggested by the aid must capture the context of the emergency; for example, in some emergencies pilots were willing to violate flight envelope limits to reduce time in flight - in other emergencies the opposite was found.
Author
*Flight Simulation; Pilot Performance; System Failures; Trajectories; Prototypes*

**20020018019** National Transportation Safety Board, Washington, DC USA
**Transportation Initial Decisions and Orders and Board Opinions and Orders Adopted and Issued During the Month of June 2000**
Jun. 2000; 58p; In English
Report No.(s): PB2000-916706; NTSB/IDBOO-00/06; No Copyright; Avail: National Technical Information Service (NTIS)
This publication contains all Judge Initial Decisions and Board Opinions and Orders in Safety and Seaman Cases for June 2000.
NTIS
*Decisions; Air Transportation; Aerospace Safety; Law (Jurisprudence)*

**20020018046** Civil Aerospace Medical Inst., Oklahoma City, OK USA

**Caring for Precious Cargo, Part 1, Emergency Aircraft Evacuations With Infants Onto Inflatable Escape Slides** ***Final Report***

Corbett, Cynthia L., Civil Aerospace Medical Inst., USA; November 2001; 24p; In English

Contract(s)/Grant(s): FAA-AM-B-00-PRS-93

Report No.(s): DOT/FAA/AM-01/18-Pt-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Twenty-nine survivable aircraft accidents between 1970 and 1995 required the emergency evacuation of 67 infants. Thirty-four percent of the infants received minor to fatal injuries. With the exception of full-scale Type Certifications in which infant dolls are included but not studied, simulated emergency evacuations and evacuation research rarely include infants and young children. The purpose of this study was to determine the most favorable protocol for the evacuation of infants via an inflatable emergency evacuation slide. Simulated emergency evacuations were conducted from the Civil Aerospace Medical Institute Aircraft Evacuation Facility, using a Type I exit fitted with a Boeing 737 evacuation slide. Six groups of 32 adult evacuees participated in six evacuation trials. Eight evacuees in each group carried one of eight dummies representative of infants ranging from two to 24 months old. On the first and last trials, no instructions were given as to how the dummies should be carried or how to board the slide. The intervening trials included instructions to carry the dummy horizontally or vertically and to jump onto the slide or sit on the slide to board. Results were analyzed with respect to speed of egress relative to the effects of the carrying and boarding positions. Subject responses to a questionnaire regarding comfort and safety were also analyzed. For speed of egress, MANOVA revealed a main effect for slide boarding (p less than 0.001), with no effect for carrying position and no interaction effects. Subjects reported that jumping onto the slide was easier than sitting to board the slide. Results confirmed the expectation that jumping onto the evacuation slide would produce faster egress rates than sitting and sliding while carrying an infant. Results also suggested that appropriate carrying and boarding positions would be those most comfortable for the parent and those providing support for the child's head and neck.

Author

*Evacuating (Transportation); Children; Aircraft Accidents; Emergencies*

**20020018829** Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France

**Ice Accretion Simulation Evaluation Test** ***Essai d'Evaluation de la Simulation de l'Accumulation de Glace***

Kind, R. J., Research and Technology Organization, France; November 2001; 32p; In English; CD-ROM contains full text document in PDF format

Report No.(s): RTO-TR-038; AC/323(AVT-006)TP/26; ISBN 92-837-1072-X; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NATO-RTO Task Group assessed computer codes for the prediction of ice accretion on aeroplanes which is an important flight safety issue. The following topics were treated: 1) state of the art; 2) review codes in use or being developed; 3) provide reliability data for regulation and certification; 4) ice shape comparison methods; and 5) critical research needs. In order to compare the detail of codes a workshop was held involving experts from various institutions and companies.

Author

*Computer Programs; North Atlantic Treaty Organization (NATO); Computerized Simulation; Aircraft Icing; Aircraft Performance; Aeronautics; Flight Tests*

**20020018876** Air Command and Staff Coll., Maxwell AFB, AL USA

**Information Operations: Moving From Doctrine to Execution**

Munipalli, Seshagiri; Apr. 1999; 53p; In English; Original contains color images

Report No.(s): AD-A397043; AU/ACSC/239/1999-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The world is in a midst of an information technology revolution. The military force that best exploits and defends information and information systems will have the military advantage in the 21st Century battlespace. Much of the information and information systems that the military uses resides on the National Information Infrastructure (NII), which itself is inter-connected with the Global Information Infrastructure (GII). Consequently, vulnerabilities and threats to the GII and NII will impact not only military systems but also future military operations. Recognizing the potential of both the USA military and an adversary to exploit these vulnerabilities, the Joint Staff and the USAF have published their doctrines on information operations (IO). At the same time, the USAF is reorganizing its operational structure to a forward-deployed air expeditionary force. As a result, IO will play a greater role in enhancing the application of aerospace power against a future adversary. This research paper describes the roots of information superiority as envisioned in top-level visionary documents and the current IO doctrine. The research also discusses

potential legal restrictions on IO and identifies some IO targets and threats. This paper also raises several issues with the USAF doctrine and recommends several steps for executing IO as the USAF transitions to an expeditionary force.
DTIC
*Warfare; Io; Targets; Military Technology*

**20020018879** Naval Postgraduate School, Monterey, CA USA
**Hardware Integration of Parachute Guidance, Navigation, and Control for the Affordable Guided Airdrop System (AGAS)**
Johnson, James G.; Sep. 2001; 189p; In English
Report No.(s): AD-A397071; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche
This study is a continuation of a previous work concerning the Affordable Guided Airdrop System (AGAS), a parachute structure that integrates low-cost guidance and control into fielded cargo air delivery systems. This thesis sought to integrate the previous studies and algorithms into developmental prototypes for test and evaluation (DT&E). Several objectives and tasks were completed in the course of this research and development. A RealSim(registered) executable on an Integrated Systems, Incorporated (ISI) AC-104 real-time controller integrated actual Vertigo(registered), pneumatic muscle actuators (PMAs) into the MATRIX(registered) environment simulation model used in the previous work to validate, analyze and improve the simulation model. A ground station utilizing the model's control algorithms, a downlink of platform position and attitude data, and a Futaba(registered) Pulse Code Modulated uplink demonstrated controlled guidance of a round cargo parachute (G-12). This system evolved as an RS-232 serial control RF modem uplink replaced the PCM signal. After evaluating, validating, and improving the algorithms from ground station control the model was written in C-code for incorporation into an autonomous system. The results from the drops were then analyzed again in the MATRIX_X(registered) model to improve the model and further qualitatively evaluate optional control strategies. Conclusions and recommendations for further study were drawn from this project.
DTIC
*Navigation; Parachutes; Airdrops; Guidance (Motion); Environment Simulation; Attitude (Inclination)*

**20020019010** Air Command and Staff Coll., Maxwell AFB, AL USA
**21ST Century Warfare: Is the AEF Ready to Play?**
Shelton, Fredrick D.; McLachlan, Russell T.; Apr. 1999; 47p; In English
Report No.(s): AD-A397039; AU/ACSC/126/1999-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Nearly eight decades have passed since early aviators like Billy Mitchell and Guilio Douhet first advocated strategic air power theory. Their original ideas still permeate all aspects of U.S. Air Force basic doctrine. The Air Expeditionary Force (AEF) concept is based on this notion of rapid deployment of strike forces anywhere in the world, and single-handedly sustaining operations in that region. The basic flaw of the AEF plan is to be based in the continental U.S. (CONUS). With no access in theatre, how will the Air Force achieve sustained air superiority? This paper will prove the AEF's present configuration cannot support all theatres due to limited access, insufficient mobility assets, and logistical support problems. This paper compares the capabilities and limitations of the AEF and Carrier Battle Group (CVBG) with regards to expeditionary features. We then apply the Navy and Air Force capabilities to real world scenarios to analyze the validity of current force structures. With the end of the Cold War, collapse of the Russian economy, and a renewed push for global democratization, many question the need for a robust military. The effectiveness of both, the AEF and CVBG will be discussed. Lastly, we give recommendations for revisions to the AEF, enabling its effective participation in future joint operations.
DTIC
*Aircraft Pilots; Politics; Mobility; Operational Problems*

**20020019012** Washington Univ., Dept. of Systems Science and Mathematics, Saint Louis, MO USA
**Artificial Intelligence Methodologies in Air Transportation Network Routing and Scheduling** ***Final Report, 1 May 1996-30 Nov. 1998***
Rodin, Ervin Y.; Apr. 14, 2000; 5p; In English
Contract(s)/Grant(s): F49620-96-1-0151; F49620-96-1-0218
Report No.(s): AD-A397000; AFRL-SR-BL-TR-01-0612; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objectives of this final report are to support faculty, as well as graduate and undergraduate students, to develop improved methodologies for the scheduling and routing of military transport aircraft; and to do so in collaboration with personnel from Flight XPY at the USAF Air Mobility Command, Scott AFB, IL.
DTIC
*Air Transportation; Artificial Intelligence; Scheduling; Transportation Networks; Neural Nets; Optimization*

**20020019553** Washington Univ., Dept. of Systems Science and Mathematics, Saint Louis, MO USA
**Graduate and Undergraduate Studies in Optimizing Air Transport Scheduling and Routing** ***Final Report, 1 Jul. 1996-30 Jun. 1999***
Rodin, Ervin Y.; Apr. 14, 2000; 5p; In English
Contract(s)/Grant(s): F49620-96-1-0218
Report No.(s): AD-A396995; AFRL-SR-BL-TR-01-0613; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The reason for submitting a single final report for two projects is that the graduate and undergraduate students who were supported by the second of these projects, actually worked on the subject matter of the first one. This project has been an ongoing one, in collaboration with the personnel from HQ (Head quarters)/ AMC (Air Mobility Command) /XPY at Scott AFB (Air Force Base). The various joint projects undertaken are presented and discussed at frequent periodic meeting between the personnel of HQ/AMC/XPY and members of the Center for Optimization and Semantic Control at Washington University.
DTIC
*Computerized Simulation; Air Transportation*

**20020020454** Air War Coll., Maxwell AFB, AL USA
**Bomber Requirements: From the Top-Down**
Seager, Samuel C.; Apr. 1998; 76p; In English; Original contains color images
Report No.(s): AD-A397231; AU/AWC/214/1998-04; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
This research effort defines bomber force requirements with one eye on national security and military strategy and the other on the future. It attempts to bridge our leadership's void in defining future roles and requirements for the nation's bomber force. Targeted for developers of requirements at Headquarters Air Force and Air Combat Command, this paper distills the lessons of historical bomber operations as well as guidance contained in documents ranging from the National Security Strategy through Air Force Basic Doctrine to define the current roles and capabilities demanded of bombers. The paper then tackles the nature of future conflict and the unique missions and capabilities required by that operating environment. As a capstone, the paper then delineates specific requirements in terms of avionics, weaponry, logistics, and training. This synthesis of requirements forms a modernization roadmap ensuring the responsiveness and viability of the US bomber force in supporting military strategy across the spectrum of future conflict.
DTIC
*Avionics; Bomber Aircraft; Military Operations; Security*

**20020020457** Air War Coll., Maxwell AFB, AL USA
**The Battle of Khafji: An Assessment of Airpower**
Palmer, Peter S.; Scott, David J.; Toolan, John A.; Apr. 14, 1998; 48p; In English
Report No.(s): AD-A397227; AU/AWC/192/1998-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
General Bernard Trainor has called the Battle of Khafji the defining moment of Desert Storm. General Charles Link has stated we must reexamine how we spend our defense dollars to restructure our future forces due to Khafji. Three former USAF Chiefs of Staff all recognized Khafji as a marker of airpower's ability to leverage sensors and new weapons to gain the advantage over enemy maneuver forces. This study examines Khafji to see if the ability of airpower to exploit the ground maneuvers elements exists and if it does decisively win the battle. to adequately examine the full scope of the battle, a joint team was formed. The study examines the ability of airpower to single-handedly decide the outcome of a battle. It is about finding the Iraqi intent. It is about assessing the Command, Control, Communications, Computers, Intelligence, Reconnaissance, and Surveillance during the battle and analyzing how it controlled the battle space. It appraises the Battle Damage Assessment and how it failed to correctly assess the destruction on the battlefield, both physical and functional. and it looks at our emerging Doctrine as seen through the eyes of this single battle. This study will look at these areas and analyzes them in the context of Khafji and whether airpower can decisively win the battle.
DTIC
*Warfare; Persian Gulf; Military Technology; Air Defense*

**20020020461** Air Command and Staff Coll., Maxwell AFB, AL USA

**High-Speed Flight and the Military**

Molloy, Matthew H.; Apr. 1999; 60p; In English; Original contains color images

Report No.(s): AD-A397157; AU/ACSC/136/1999-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper makes a qualitative assessment of NASA's High-Speed Research program and its associated High-Speed Civil Transport (HSCT) program to answer the question of whether or not this Mach 2.4-class, 300 passenger transport and its supersonic business jet (SSBJ) counterpart could have value to future military operations. This research found that supersonic transports such as the HSCT and the SSBJ could be in production within 10-20 years. Based on the projected operating capabilities of the HSCT and the SSBJ, this paper presents several plausible military missions these vehicles could support. The list includes: rapid transoceanic support of AEF operations and priority airlift missions; aeromedical support; CINC and distinguished visitor movement, special operations support, and crisis response support. This paper then presents a plan for which a future bomber could be developed based on the technology and research generated by the High-Speed Research program. This bomber would provide a critical next-step towards achieving a hypersonic flight (Mach 5 or faster) vehicle. Military investment in the High-Speed Research program would yield benefits beyond a next-generation bomber. It would also stimulate the civil aerospace sector's production of the HSCT and thereby provide both the military and the nation quicker access to a supersonic transport capability. DTIC

*Bomber Aircraft; Civil Aviation; Supersonic Transports; Military Technology*

**20020020970** Naval Postgraduate School, Monterey, CA USA

**Information Management System Development for the Investigation, Reporting, and Analysis of Human Error in Naval Aviation Maintenance**

Nelson, Douglas B.; Sep. 2001; 96p; In English

Report No.(s): AD-A397263; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The purpose of this research is to evaluate and refine a safety information management system that will facilitate data collection, organization, query, analysis and reporting of maintenance errors that contribute to Naval Aviation mishaps, equipment damage and personnel injury using OPNAV 3750.6R, Human Factors Analysis and Classification System Maintenance Extension taxonomy. The target audience for this information management system tool included safety personnel, mishap investigators, Aircraft Mishap Board (AMB) members, and analysts. A review of three areas was needed to refine the prototype tool: (1) the collection, use and management of accident information, (2) human error theories as related to aviation mishaps and (3) the design of an effective mishap database tool. A usability study was conducted using potential end-users. Fifteen Naval Aviation Safety Officers and Naval Aviators were given written procedures to navigate through the prototype and an exit survey. The survey responses, including objective and subjective responses about the prototype were gathered. The results indicate, that with proper training, the prototype could provide insight into maintenance errors, which could be used to target hazards and develop intervention strategies to prevent future mishaps. DTIC

*Information Systems; Aircraft Maintenance; Errors; Aircraft Safety*

## 04
## AIRCRAFT COMMUNICATIONS AND NAVIGATION

*Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications; Spacecraft Communications, Command and Tracking, and 32 Communications and Radar.*

**20020016497** NASA Ames Research Center, Moffett Field, CA USA

**Traffic Management Advisor: Iterative Field Development and Assessment at Multiple Sites**

Sanford, Beverly D., Sterling Software, Inc., USA; Lee, Katharine K., Sterling Software, Inc., USA; Harwood, Kelly, NASA Ames Research Center, USA; [1995]; 1p; In English; 5th IFAC Symposium on Automated System Based on Human Skills, 25-28 Sep. 1995, Berlin, Germany; Sponsored by International Federation of Automatic Control, Unknown

Contract(s)/Grant(s): RTOP 505-64-13; No Copyright; Avail: Issuing Activity; Abstract Only

Previous studies have demonstrated the necessity of involving users in the development of automation aids, especially for complex domains such as air traffic control (ATC). Traditional development only demanded a single field test to validate a completed system, but a more iterative combination of development and assessment ensures that the technology meets the requirements of its application domain. Exposure across an adequate spectrum of field users is also required during development,

and the use of multiple development sites provides an opportunity to consider individual facility cultures as they relate to implementation strategies. The development of the Center/TRACON Automation System (CTAS) Traffic Management Advisor (TMA) at the Denver and Dallas ATC facilities demonstrates successful iterative development and assessment at multiple field sites. The use of field development changes the nature of assessment. As development progresses, periodic assessments are required to validate that system development is progressing along an appropriate track. In the development of the TMA, assessments were performed based on software in the field, and input from traffic managers was analyzed and incorporated into subsequent releases of the TMA, to be reassessed in the field. This has led to a tool with operational suitability and broad user acceptance. Assessment at multiple sites provides a more generalizable perspective that allows the production of a system that is both generic enough to be used at different sites and tailored enough to be of use at any site. In addition to providing a better understanding of specific facility requirements, the use of multiple assessment sites in the development of TMA has provided an opportunity to consider individual facility operations, procedures and cultures as they relate to development and implementation strategies.
Author
*Automatic Control; Domains; Systems Engineering*

**20020017252** NASA Ames Research Center, Moffett Field, CA USA
**TRACON Aircraft Arrival Planning and Optimization Through Spatial Constraint Satisfaction**
Bergh, Christopher P., Massachusetts Inst. of Tech., USA; Krzeczowski, Kenneth J., NASA Ames Research Center, USA; Davis, Thomas J., NASA Ames Research Center, USA; [1995]; 1p; In English
Contract(s)/Grant(s): RTOP 505-64-13; No Copyright; Avail: Issuing Activity; Abstract Only

A new aircraft arrival planning and optimization algorithm has been incorporated into the Final Approach Spacing Tool (FAST) in the Center-TRACON Automation System (CTAS) developed at NASA-Ames Research Center. FAST simulations have been conducted over three years involving full-proficiency, level five air traffic controllers from around the USA. From these simulations an algorithm, called Spatial Constraint Satisfaction, has been designed, coded, undergone testing, and soon will begin field evaluation at the Dallas-Fort Worth and Denver International airport facilities. The purpose of this new design is an attempt to show that the generation of efficient and conflict free aircraft arrival plans at the runway does not guarantee an operationally acceptable arrival plan upstream from the runway -information encompassing the entire arrival airspace must be used in order to create an acceptable aircraft arrival plan. This new design includes functions available previously but additionally includes necessary representations of controller preferences and workload, operationally required amounts of extra separation, and integrates aircraft conflict resolution. As a result, the Spatial Constraint Satisfaction algorithm produces an optimized aircraft arrival plan that is more acceptable in terms of arrival procedures and air traffic controller workload. This paper discusses the current Air Traffic Control arrival planning procedures, previous work in this field, the design of the Spatial Constraint Satisfaction algorithm, and the results of recent evaluations of the algorithm.
Author
*Algorithms; Automatic Control; Coding; Simulation; Workloads (Psychophysiology)*

**20020018002** National Aerospace Lab., Amsterdam, Netherlands
**Analysis and Validation of GNSS Performance**
Vermeij, J. H.; van den Berg, A. N.; Farnworth, R.; Breewer, E.; Oct. 1999; 16p; In English
Report No.(s): PB2001-108842; NLR-TP-99420; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Contents include the following: Acronyms; Biographies; Abstract; Background; Introduction; RNP parameter definitions; Validation methods; GNSS performance breakdown; Validation of GNSS performance; Simulation environment for validation; conclusions and references.
NTIS
*Performance; Navigation Satellites; Biography*

**20020018856** National Defence Research Establishment, Div. of Systems and Underwater Technology, Stockholm, Sweden
**Model of a Strapdown Inertial Navigation System** ***Modell av ett Skrovfast Troeghetsnavigeringssytem***
Pettersson, A.; Dec. 1999; 90p; In Swedish
Report No.(s): PB2001-108081; FOA-R-99-01352-616-SE; No Copyright; Avail: National Technical Information Service (NTIS)

This thesis is mainly focused on the modeling and simulation of a three-dimensional strapdown inertial navigation system. It constitutes the thesis which conclude the education to computer engineer at the University College in Kalmar. The introduction describes inertial navigation in general and the technique of strapdown inertial systems. Thereafter, the different coordinate

systems used in the thesis. The transformation between the reference systems are also treated here. The main effort in this work has been to derive and express the continuous time navigation equations in a local geographic navigation reference frame and also the corresponding model for the error growth in the states of the navigation equations (positions, attitude, and heading angles and velocity of the navigating system). Finally the simulation environment which has been implemented in MATLAB and SIMULINK is described. It consists of trajectory generation and sensor data generation which is used as input to the navigation equations. The error equations is forced by sensor noise. Simulation results from simple straight and level flight are presented mainly for verification purposes.
NTIS
*Inertial Navigation; Navigation; Computerized Simulation*

**20020018859** National Defence Research Establishment, Div. of Systems and Underwater Technology, Stockholm, Sweden
**Inertial Navigation: A Review of Fundamental Principles and Function** ***Troeghetsnavigering: Oeversikt oever Funktion och Principer***
Arnzen, S.; Apr. 1999; 45p; In Swedish
Report No.(s): PB2001-108092; FOA-R-99-01074-314-SE; No Copyright; Avail: National Technical Information Service (NTIS)

The objective of this report is to give a review of the fundamental principles and functions of platform as well as strapdown inertial navigation systems (INS) to be used as a reference for further studies within the FOA project 'Jamming of Navigation Systems.' Specifically the use of gyros and accelerometers as the main components of inertial navigation systems is explained in some detail. Finally an overview of the most important error sources is given and simple rules for estimation of the initial alignment errors are presented.
NTIS
*Accelerometers; Gyroscopes; Inertial Navigation*

**20020020446** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Flight Performance Evaluation of Three GPS Receivers for Sounding Rocket Tracking**
Bull, Barton, NASA Goddard Space Flight Center, USA; Diehl, James, Litton PRC, Inc., USA; Montenbruck, Oliver, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Markgraf, Markus, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; [2001]; 1p; In English; ION National Technical Meeting, 28-30 Jan. 2002, San Diego, CA, USA; No Copyright; Avail: Issuing Activity; Abstract Only

In preparation for the European Space Agency Maxus-4 mission, a sounding rocket test flight was carried out at Esrange,, near Kiruna, Sweden on February 19, 2001 to validate existing ground facilities and range safety installations. Due to the absence of a dedicated scientific payload, the flight offered the opportunity to test multiple GPS receivers and assess their performance for the tracking of sounding rockets. The receivers included an Ashtech G12 HDMA receiver, a BAE (Canadian Marconi) Allstar receiver and a Mitel Orion receiver. All of them provide CIA code tracking on the L1 frequency to determine the user position and make use of Doppler measurements to derive the instantaneous velocity. Among the receivers, the G12 has been optimized for use under highly dynamic conditions and has earlier been flown successfully on NASA sounding rockets [Bull, ION-GPS-2000]. The Allstar is representative of common single frequency receivers for terrestrial applications and received no particular modification, except for the disabling of the common altitude and velocity constraints that would otherwise inhibit its use for space application. The Orion receiver, finally, employs the same Mitel chipset as the Allstar, but has received various firmware modifications by DLR to safeguard it against signal losses and improve its tracking performance [Montenbruck et al., ION-GPS-2000]. While the two NASA receivers were driven by a common wrap-around antenna, the DLR experiment made use of a switchable antenna system comprising a helical antenna in the tip of the rocket and two blade antennas attached to the body of the vehicle. During the boost a peak acceleration of roughly 17g's was achieved which resulted in a velocity of about 1100 m/s at the end of the burn. At apogee, the rocket reached a maximum altitude of over 80 km. A detailed analysis of the attained flight data will be given in the paper together with a evaluation of different receiver designs and antenna concepts.
Author
*Flight Tests; Global Positioning System; Receivers; Sounding Rockets; Space Missions; Antenna Design*

## 05
## AIRCRAFT DESIGN, TESTING AND PERFORMANCE

*Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.*

**20020016153** Defence Science and Technology Organisation, Fishermans Bend, Australia

**An Investigation of the Vibration Characteristics of the Eurocopter AS35OB Main Rotor Gearbox Under Different Operating Conditions**

Wang, Wenyi; Oct. 2001; 56p; In English; Original contains color images

Report No.(s): AD-A396757; DSTO-TR-1217; DODA-AR-012-029; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Different flight conditions can introduce complex changes to the vibration of helicopter transmissions, which may cause a vibration-based in-flight transmission diagnostic system to produce false alarms. An investigation into the vibration characteristics of the Eurocopter AS 350B main rotor gearbox under different operating conditions was conducted at AMRL. This investigation provided some in-depth understanding of the effects of different operating conditions, such as speed, torque and mast load, on the vibration of the gearbox. The analysis results showed that the effects of torque load were predominant and were dependent on operating speed and sensor locations, but that the effects of mast load were limited at most sensor locations. At the sensor location near the input shaft, the effects of torque and mast load on the vibration of the AS 350B gearbox were minimal. DTIC

*Vibration; Transmissions (Machine Elements); Shafts (Machine Elements); Torque; Military Helicopters*

**20020016304** NASA Langley Research Center, Hampton, VA USA

**Hyper-X Program Status**

McClinton, Charles R., NASA Langley Research Center, USA; Rausch, Vincent L., NASA Langley Research Center, USA; Sitz, Joel, NASA Dryden Flight Research Center, USA; Reukauf, Paul, NASA Dryden Flight Research Center, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 69-82; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper provides an overview of the objectives and status of the Hyper-X program, which is tailored to move hypersonic, airbreathing vehicle technology from the laboratory environment to the flight environment. The focus of Hyper-X program is the 12-foot long X-43, hypersonic scramjet powered vehicle. Extensive risk reduction activities for the two Mach 7 flights are completed, and non-recurring design activities for the Mach 10 (3rd flight) are nearing completion. The first Mach 7 flight of the X-43, was June 2, 2001. Problems encountered in the transonic boost phase precluded reaching the scramjet test condition, but extensive data generated is being studied to verify all systems. The second flight is currently scheduled for late in CY 2001. When flown, this will be the first flight of an airframe-integrated scramjet-powered vehicle. The Hyper-X program is supporting the NASA MSFC ASTP Program in planning follow-on activities to focus an orderly continuation of hypersonic technology development through ground and flight research.

Author

*Hypersonic Vehicles; X-43 Vehicle; NASA Programs; Supersonic Combustion Ramjet Engines; Flight Tests*

**20020016483** Army Communications-Electronics Command, Fort Monmouth, NJ USA

**Using Continuous-Planning Techniques to Achieve Autonomy and Coordination Among Multiple Unmanned Aerial Vehicles**

Powell, Gerald M.; Juner 2001; 19p; In English

Report No.(s): AD-A396781; CECOM-R-01-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Existing Unmanned Aerial Vehicle (UAV) systems exhibit shortcomings in providing continuous, responsive, timely, and detailed information and targeting support to Army tactical commander's combat operations in an Army XXI battlespace. to synchronize Tactical UAV (TUAV) missions with supported operations, time is the critical element. Anything that can reduce TUAV planning time, while maintaining plan effectiveness, will expedite execution of a TUAV1s mission. Autonomous flight with some ability to avoid and evade certain threats would increase survivability further. This paper begins by presenting some of the recent successes achieved by artificial intelligence (AI) planners and schedulers on complex real-world problems. It then attempts to show how NASA's demonstrated utility of a dynamic Al planning system prototype for conducting autonomous distributed planning and execution for a team of rovers engaged in missions to achieve science goals during planetary operations

can be generalized and applied to a team of TUAVs. Last, it discusses some data collection opportunities that should appear due to the ability to place increasingly more processing and data storage capabilities onboard TUAVs and some of the key challenges to use those capabilities to produce more timely and immediately usable interpretations.
DTIC
*Artificial Intelligence; Military Operations; Pilotless Aircraft; Planning; Military Technology*

**20020017229** RAND Corp., Santa Monica, CA USA
**Military Airframe Costs. The Effects of Advanced Materials and Manufacturing Processes**
Younossi, Obaid; Kennedy, Michael; Graser, John C.; Jan. 2001; 160p; In English
Contract(s)/Grant(s): F49462-01-C-0003
Report No.(s): AD-A396701; RAND/MR-1370-AF; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
Good cost estimates can make important contributions to effective acquisition policy. RAND has a long history of producing cost-estimating methodologies. Two of its more recent studies are Hess and Romanoff (1987) and Resetar, Rogers, and Hess (1991). This report both updates and extends these earlier studies, focusing on the effects of material mix, manufacturing technique, and part geometric complexity on cost. We collected two types of information on these effects. First, we surveyed the military airframe industry for estimates of how aircraft production costs vary with airframe structure material mix. Second, we analyzed a large set of actual part data from recent aircraft manufacturing efforts that we collected from industry. We also estimated a set of airframe relationships (CERs) for labor hours based on MACDAR, a historical airframe database. We then integrated the effects of material mix into these estimates.
DTIC
*Military Aircraft; Cost Estimates; Airframes; Aircraft Structures*

**20020017472** National Defence Research Establishment, Linkoeping, Sweden
**Adhesion of Low Emissive coatings on PMMA Substrates**
Lee, H. S.; Staaf, O.; Georgson, M.; Dec. 1999; 20p; In English
Report No.(s): PB2001-108430; FOA-R-99-01312-615-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Aircraft canopies are exposed to erosion during flight. It is difficult to combined the desired optical and mechanical properties of canopy coatings. It is favorable to have a low emissive coating on the canopy in order to reduce the emitted infrared radiation from the cockpit as well as reduces the emittance from the canopy caused by aerodynamic heating. The final multilayer structure includes a layer of Teflon for protection, but this report is focused on the adhesion between the substrate and the metal film. Visually transparent layers of titanium nitride, gold, silver, and aluminum were deposited by sputtering onto PMMA substrates. Prior to the deposition, the substrates were cleaned in a glow discharge process in the load lock chamber. The surface modification of the cleaning process aimed at improving the adhesion of the thin metallic layer. However, the Scotch 3M tape test indicates that the adhesion was not improved by the pretreatment of the substrate surface. A water jet test, to study the rain erosion resistance, showed that the extra layer of metal did not effect the abrasive properties of the surface. From literature, it is known that a surface treatment of glow discharge improves the adhesion of metal layers on plastic surfaces. Therefore, additional work on the treatment prior to sputter deposition needs to be done.
NTIS
*Adhesion; Coatings; Aircraft Structures; Corrosion Resistance; Aerodynamic Heating*

**20020017999** National Aerospace Lab., Amsterdam, Netherlands
**Pilot Model for Helicopter Maneuvers**
van der Vorst, J.; Jan. 2001; 30p; In English
Report No.(s): PB2001-108847; NLR-TP-98448; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The primary goal of the research described in this paper was the development of a pilot model with which offline simulations can be performed of piloted helicopter maneuvers, such as ADS33D Flight Test Maneuvers. In order to develop such a pilot model, a literature study was performed about the types of pilot models available. Furthermore, to determine the underlying structure of the controlling and guiding process, pilots were interviewed about how they executed certain maneuvers and discerned the various phases within a maneuvering task.
NTIS
*Helicopter Control; Flight Simulation; Maneuvers*

**20020018045** Research and Technology Organization, Neuilly-sur-Seine, France

**RTO Technical Publications: A Quarterly Listing** ***Quarterly Report, 1 Oct. - 31 Dec. 2001***

December 2001; 1p; In English

Report No.(s): RTO-01-04; Copyright Waived; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this AGARDograph is to provide an introductory overview of logistics test and evaluation methods for supportability testing. This AGARDograph is an attempt to put into print the approach and techniques for a test team to execute logistics/supportability test and evaluation. to do so, the logistics/supportability test and evaluation process is subdivided into manageable functional areas and disciplines called Integrated Logistics Support (ILS) elements. The 10 ILS elements are: maintenance planning; manpower and personnel; support equipment; computer resources; facilities; packaging, handling, storage, and transportation; and design interface. Whether a program is a large one, like a new F-22 aircraft, or a small one, like a new 25K Loader, all logistics elements must be evaluated for applicability to the program. The only change between large and small programs is the depth of effort to be performed in each element. Examples will be provided to discuss the test and evaluation technique to each area and are adaptable to the reader's particular area of interest. This volume should complement the AG-300 Vol.13 on "Reliability and Maintainability."

Author

*Logistics; Flight Tests; Support Systems*

**20020018623** Physics and Electronics Lab. TNO, The Hague, Netherlands

**Support of Apache Tactics Development** ***Final Report Ondersteuning Tactiekontwikkeling Apache***

Jansen, R. E. J., Physics and Electronics Lab. TNO, Netherlands; Janssen, H. G. M., Physics and Electronics Lab. TNO, Netherlands; Overmaat, J. G. H., Physics and Electronics Lab. TNO, Netherlands; Stout, R., Physics and Electronics Lab. TNO, Netherlands; Visser, B. J., Physics and Electronics Lab. TNO, Netherlands; vandeWiel, R. A. N., Physics and Electronics Lab. TNO, Netherlands; April 2001; 124p; In Dutch

Contract(s)/Grant(s): A00KLu/790/814; TNO Proj. 29605/29741

Report No.(s): TD00-0433; FEL-01-A087; Copyright; Avail: Issuing Activity

The Royal Netherlands Airforce is reaching for the Full Operational Capable status for their Tactical Helicopter Group. One way to achieve this status efficiently, is to support tactics development for Apache attack helicopters by simulation. More specifically, the TNO-FEL Electronic Battlespace Facility is a possible and available option for this purpose. A case-scenario was developed to evaluate the possibilities of the facility. During this project, insight was gained into the tactics development process and the measures of effectiveness involved.

Author

*Military Helicopters; Computerized Simulation; Tactics*

**20020019044** NASA Marshall Space Flight Center, Huntsville, AL USA

**Lightweight Chambers for Thrust Assemblies**

Elam, S., NASA Marshall Space Flight Center, USA; Lee, J., NASA Marshall Space Flight Center, USA; Holmes, R., NASA Marshall Space Flight Center, USA; Zimmerman, F., NASA Marshall Space Flight Center, USA; Jul. 12, 2001; 11p; In English; 52nd International Astronautical Congress, 1-5 Oct. 2001, Toulouse, France

Contract(s)/Grant(s): NRA8-21

Report No.(s): IAF-01-S.3.05; Copyright; Avail: Issuing Activity

New materials and fabrication techniques have been successfully used to create actively cooled thrust chambers that weigh less, and potentially operate hotter, than conventional designs. Results could improve the performance and payload capacity of many vehicles, including new Reusable Launch Vehicle (RLV) concepts. Polymer Matrix Composite (PMC) and Metal Matrix Composite (MMC) materials replaced traditional metal alloys for structural jackets and manifolds. Ceramic Matrix Composite (CMC) materials and an advanced copper alloy (GRCop-84) were used for chamber liners to significantly increase operating temperatures. Several small chambers were fabricated and tested with promising results to demonstrate that designs over 50% lighter are feasible. New fabrication techniques were demonstrated, including an advanced casting technique and a low cost vacuum plasma spray process. Based on the favorable results for the MMC, PMC and GRCop-84 materials, similar concepts were applied to larger chamber designs. These larger units are currently being fabricated for testing in 2001. Hot-fire testing on the larger units will directly compare performance results between a conventional chamber design and these "lightweight" alternatives. The technology developed and demonstrated by this effort could benefit new RLV programs, as well as other existing and future engine designs.

Author

*Engine Design; Thrust Chambers; Cooling Systems; Design Analysis; Metal Matrix Composites; Combustion Chambers*

**20020019068** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia
**Prediction of Buffet Loads Using Artificial Neural Networks**
Levinski, Oleg; Sep. 2001; 39p; In Dutch; In English
Report No.(s): AD-A396975; DSTO-RR-02188; DODA-AR-012-019; X5-X5; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of artificial neural networks (ANN) for predicting the empennage buffet pressures as a function of aircraft state has been investigated. The buffet loads prediction method which is developed depends on experimental data to train the ANN algorithm and is able to expand its knowledge base with additional data. The study confirmed that neural networks have a great potential as a method for modelling buffet data. The ability of neural networks to accurately predict magnitude and spectral content of unsteady buffet pressures was demonstrated. Based on the ANN methodology investigated, a buffet prediction system can be developed to characterize the F/A-18 vertical tail buffet environment at different flight conditions. It will allow better understanding and more efficient alleviation of the empennage buffeting problem.
DTIC
*Neural Nets; Tail Assemblies; Prediction Analysis Techniques; Buffeting*

**20020019417** National Academy of Sciences - National Research Council, Washington, DC USA
**Aging Avionics in Military Aircraft** ***Final Report, 15 Feb. 2000-14 May 2001***
May 11, 2001; 75p; In English
Contract(s)/Grant(s): F49620-00-1-0174
Report No.(s): AD-A397119; AFSB-J99-03-A; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The NRC was asked by the Assistant Secretary of the Air Force for Acquisition to examine issues associated with aging avionics in military aircraft. An ad hoc Committee was formed under the Air Force Science and Technology Board and the Commission on Engineering and Technical Systems (now Division on Engineering and Physical Systems) at the National Academy of Sciences in February 2000. The National Academies was tasked to gather all pertinent information, include a review of Diminishing Manufacturing Sources, and provide recommendations on new approaches and innovative techniques to improve management of aging avionics. The overall goal was to help the Air Force to enhance supportability and replacement of aging and obsolescing avionics and minimize associated life cycle costs. Avionics systems, like all computer-based systems, are operating on a life cycle of about two to three years, while the systems within which they are imbedded have life cycles as long as several decades. This report identified management, technical, and business issues and solutions to the problem of aging and obsolescing avionics systems in military aircraft.
DTIC
*Avionics; Military Aircraft; Systems Engineering; Life (Durability); Management Planning*

**20020019418** Analytic Designs, Inc., Columbus, OH USA
**Sub-Aperture Antenna Modeling on Fixed Wing Aircraft** ***Final Report, Jun. 2000-May 2001***
Kominek, Allen K.; Shamansky, Harry T.; Jul. 2001; 12p; In English
Contract(s)/Grant(s): F30602-00-C-0185; ARPA Order J491; AF Proj. J491
Report No.(s): AD-A397118; AFRL-SN-RS-TR-2001-152; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The far field, volumetric radiation patterns for three antenna array configurations installed on a DeHavilland Dash 7 aircraft was determined. The arrays consisted of twenty-six sub-elements that were individually excited to allow arbitrary weighting for post pattern generation. The first two array configurations consisted of dipole elements offset from a ground plane. The third array configuration consisted of a slot element simulating a TEM horn antenna. All pattern data was formatted to be compatible with Air Force Research Laboratory's radar system analysis software.
DTIC
*Fixed Wings; Antenna Design; De Havilland Aircraft; Aircraft Configurations; Mathematical Models; Apertures; Far Fields*

**20020020468** Air War Coll., Maxwell AFB, AL USA
**Uninhibited Combat Air Vehicles and Commercial Satellites: 'The Missing Link'**
Nichols, Mark; Apr. 1998; 45p; In English
Report No.(s): AD-A397134; AU/AWC/RWP/188/1998-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the not too far distant future, a new Uninhabited Combat Air Vehicle (UCAV), a cousin of the UAVs flying over Bosnia today, is destined to fly the most sensitive and dangerous missions the US Air Force is expected to accomplish. This vehicle, though uninhabited, will not operate in a vacuum, but instead will be supported by the most sophisticated network of satellite communications the nation can offer. Today, as our engineers develop a concept that will fly in the first quarter of the 21st century,

most of the satellites that will be used to support this aircraft are already in design or in orbit. The Air Force Space Architecture Plan, released in 1996, projects that during the time frame that the UCAV is envisioned to be operational, the US military satellite communications network will be operating. This paper examines the risk mentioned in the space architecture plan. It argues that the use of the newest commercial satellite constellations already in the process of being launched gives the Department of Defense (DoD) a unique opportunity to meet the warfighter's needs, and argues that commercial low earth orbiting (LEO) satellites is an integral part of the DoD's strategy for the UCAV. The exploitation and partnership with the civil community offers the US a reliable and redundant backup capability by utilizing the technology enhancements already funded and marketed by the commercial space industry. The integration of commercial satellites is the UCAV's 'Missing Link'.
DTIC
*Commercial Spacecraft; Satellite Communication; Pilotless Aircraft*

## 07
## AIRCRAFT PROPULSION AND POWER

*Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.*

**20020016305** General Applied Science Labs., Inc., Ronkonkoma, NY USA
**Test Medium Effects on Ignition, Combustion and Flameholding Processes in Scramjet Combustors**
Chinitz, W., General Applied Science Labs., Inc., USA; Pellett, G. L., NASA Langley Research Center, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 83-112; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The total temperatures (enthalpies) required to ground-test air-breathing (aero-propulsion) engines at high Mach number flight conditions can be achieved in a number of ways. Among these are: heat exchangers, including pre-heated ceramic beds, direct electrical heating, e.g., arc discharge and resistance heaters, compression heating, shock heating, and in-stream combustion, with oxygen replenishment to match air content. Each method has distinct advantages, disadvantages and limitations. All have a common characteristic of being designed for intermittent flow, due to the extreme energy required for continuous operation at simulated Mach numbers above about 3. All also distort the composition of atmospheric air to some degree, due to the high temperatures that occur in a plenum section prior to expansion of the flow to simulated flight conditions. In the case of in-stream combustion, the resulting test medium is commonly referred to as "vitiated air', being composed of oxygen, nitrogen and some fraction of combustion products. Table 1 lists mole percentages of several gaseous air contaminants in wind tunnels due to typical methods of generating high enthalpy supersonic flow. The presence of very large amounts of steam, and much smaller but potentially reactive quantities of nitric oxide (NO) and free radicals, e.g. OH and O, are of concern for both hydrogen- and hydrocarbon-vitiated air. Nitric oxide formation with attendant O2 depletion are major contaminant "sources" in facilities using arc heaters. Carbon dioxide, CO, and residual CxHyOz molecular/radical species are additional air contaminants in hydrocarbon-vitiated air. Furthermore, deviations in the control of O2 makeup, departures from complete mixing and combustion in a facility heater, and incomplete recombination in a facility nozzle, may cause significant deviations in downstream test simulations. Finally, methods for producing very high enthalpy flow, e.g. a piston-driven reflected shock tunnel or a shock/detonation-driven expansion tube, may alter the test gas drastically. Significant O-atom production may profoundly affect ignition/combustion kinetics. Also, relaxation rates of vibrationally-excited O2 and N2 are greatly accelerated by steam. Thus various generated air contaminants introduce uncertainty in scramjet testing, and may even require compensation to achieve "clean air performance."
Author
*Combustion Physics; Ignition; Supersonic Combustion Ramjet Engines; Atmospheric Chemistry; Diatomic Gases; Reaction Kinetics*

**20020016306** Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
**Pulse Detonation Propulsion Systems**
Coleman, Mark L., Johns Hopkins Univ., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 113-126; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Propulsion systems based on the pulsed detonation cycle offer the potential to provide increased performance while simultaneously reducing engine weight, cost, and complexity, relative to conventional propulsion systems currently in service. These improvements can be traced to the high thermodynamic efficiency of the nearly constant-volume combustion cycle and

the low entropy rise in the working fluid produced by detonation. Pulse detonation engines may require less packaging volume than conventional propulsion systems due to their inherent design simplicity. The pulse detonation cycle can be applied to both airbreathing and rocket-based systems, and airbreathing pulse detonation engines can potentially operate over a wide range of flight Mach numbers (M=0 to 5). These characteristics combine to make pulse detonation propulsion systems attractive for a wide range of military and commercial missions. The near constant-volume heat addition process of the detonation cycle, along with the lack of a compression cycle contribute to the theoretical high efficiency, high specific impulse, overall design simplicity, and low-cost potential of pulse detonation propulsion systems. Application of the pulsed detonation cycle requires coupling the high thermal efficiency of the detonation cycle with high propulsion efficiency in a practical device. This paper discusses the operational characteristics of pulse detonation propulsion devices, and identifies some of the major scientific and engineering issues that must be successfully addressed before operation of practical pulse detonation propulsion systems becomes a reality. Author

*Propulsion System Performance; Pulse Detonation Engines; Air Breathing Engines; Thermodynamic Efficiency*

**20020016307** Sverdrup Technology, Inc., Arnold AFB, TN USA

**Multi-Level Analysis of Pulsed Detonation Engines**

Ebrahimi, Houshang B., Sverdrup Technology, Inc., USA; Mohanraj, Rajendran, Tennessee Univ., USA; Merkle, Charles L., Tennessee Univ., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 127-158; In English; Also announced as 20020016300

Contract(s)/Grant(s): NAS8-97301; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The present study explores some issues concerning the operational performance of pulsed detonation engines. Zero-, one- and two-dimensional, transient models are employed in a synergistic manner to elucidate the various characteristics that can be expected from each level of analysis. The zero-dimensional model provides rapid parametric trends that help to identify the global characteristics of pulsed detonation engines. The one-dimensional model adds key wave propagation issues that are omitted in the zero-dimensional model and helps to assess its limitations. Finally, the two-dimensional model allows estimates of the first-order multi-dimensional effects and provides an initial multi-dimensional end-correction for the one-dimensional model. The zero-dimensional results indicate that the pulsed detonation engine is competitive with a rocket engine when exhausting to vacuum conditions. At finite back pressures, the PDE out-performs the rocket if the combustion pressure rise from the detonation is added to the chamber pressure in the rocket. If the two peak pressures are the same, the rocket performance is higher. Two-dimensional corrections added to the one-dimensional model result in a modest improvement in predicted specific impulse over the constant pressure boundary condition.

Author

*Pulse Detonation Engines; Mathematical Models; Propulsion System Performance; Numerical Analysis*

**20020016714** Georgia Tech Research Inst., Aerospace and Acoustics TEchnologies Branch, Atlanta, GA USA

**Distributed Exhaust Nozzles for Jet Noise Reduction** ***Final Report***

Ahuja, K. K., Georgia Tech Research Inst., USA; Gaeta, R. J., Georgia Tech Research Inst., USA; Hellman, B., Georgia Tech Research Inst., USA; Schein, D. B., Northrop Grumman Corp., USA; Solomon, W. D., Jr., Northrop Grumman Corp., USA; Dec. 31, 2001; 134p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG3-2352

Report No.(s): GTRI-Rept-A6221/2001-1; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The main objective of this study is to validate the jet noise reduction potential of a concept associated with distributed exhaust nozzles. Under this concept the propulsive thrust is generated by a larger number of discrete plumes issuing from an array of small or mini-nozzles. The potential of noise reduction of this concept stems from the fact that a large number of small jets will produce very high frequency noise and also, if spaced suitably, they will coalesce at a smaller velocity to produce low amplitude, low frequency noise. This is accomplished through detailed acoustic and fluid measurements along with a Computational Fluidic Dynamic (CFD) solution of the mean (DE) Distributed Exhaust nozzle flowfield performed by Northrop-Grumman. The acoustic performance is quantified in an anechoic chamber. Farfield acoustic data is acquired for a DE nozzle as well as a round nozzle of the same area. Both these types of nozzles are assessed numerically using Computational Fluid Dynamic (CFD) techniques. The CFD analysis ensures that both nozzles issued the same amount of airflow for a given nozzle pressure ratio. Data at a variety of nozzle pressure ratios are acquired at a range of polar and azimuthal angles. Flow visualization of the DE nozzle is used to assess the fluid dynamics of the small jet interactions. Results show that at high subsonic jet velocities, the DE nozzle shifts its frequency of peak amplitude to a higher frequency relative to a round nozzle of equivalent area (from a S(sub tD) = 0.24 to 1. 3). Furthermore, the DE nozzle shows reduced sound pressure levels (as much as 4 - 8 dB) in the low frequency part of the spectrum (less than S(sub

tD) = 0.24 ) compared to the round nozzle. At supersonic jet velocities, the DE nozzle does not exhibit the jet screech and the shock-associated broadband noise is reduced by as much as 12 dB.
Author
*Acoustic Measurement; Computational Fluid Dynamics; Exhaust Nozzles; Jet Aircraft Noise; Noise Reduction*

**20020018895** NASA Glenn Research Center, Cleveland, OH USA
**Advanced Methods for Aircraft Engine Thrust and Noise Benefits: Nozzle-Inlet Flow Analysis**
Gilinsky, Mikhail, Hampton Univ., USA; Morgan, Morris H., Hampton Univ., USA; Povitsky, Alex, Hampton Univ., USA; Schkolnikov, Natalia, Hampton Univ., USA; Njoroge, Norman, Hampton Univ., USA; Coston, Calvin, Hampton Univ., USA; Blankson, Isaiah M., NASA Glenn Research Center, USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 22; In English; Also announced as 20020018881
Report No.(s): P14; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Fluid Mechanics and Acoustics Laboratory at Hampton University (HU/FM&AL) jointly with the NASA Glenn Research Center has conducted four connected subprojects under the reporting project. Basically, the HU/FM&AL Team has been involved in joint research with the purpose of theoretical explanation of experimental facts and creation of accurate numerical simulation techniques and prediction theory for solution of current problems in propulsion systems of interest to the NAVY and NASA agencies. This work is also supported by joint research between the NASA GRC and the Institute of Mechanics at Moscow State University (IM/MSU) in Russia under a CRDF grant. The research is focused on a wide regime of problems in the propulsion field as well as in experimental testing and theoretical and numerical simulation analyses for advanced aircraft and rocket engines. The FM&AL Team uses analytical methods, numerical simulations and possible experimental tests at the Hampton University campus. The fundamental idea uniting these subprojects is to use nontraditional 3D corrugated and composite nozzle and inlet designs and additional methods for exhaust jet noise reduction without essential thrust loss and even with thrust augmentation. These subprojects are: (1) Aeroperformance and acoustics of Bluebell-shaped and Telescope-shaped designs; (2) An analysis of sharp-edged nozzle exit designs for effective fuel injection into the flow stream in air-breathing engines: triangular-round, diamond-round and other nozzles; (3) Measurement technique improvement for the HU Low Speed Wind Tunnel; a new course in the field of aerodynamics, teaching and training of HU students; experimental tests of Mobius-shaped screws: research and training; (4) Supersonic inlet shape optimization. The main outcomes during this reporting period are: (l) Publications: The AIAA Paper #00-3170 was presented at the 36th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 17-19 June, 2000, Huntsville, AL. The AIAA Paper #01-1893 has been accepted for the AIAA/NAL-NASDA-ISAS 10th International Space Planes and Hypersonic Systems and Technologies Conference, 24-27 April 2001, Kyoto, Japan. The AIAA Paper #01 -3204 has been accepted for presentation at the 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, being held on 08-11 July, in Salt Lake City, UT; (2) A U.S. patent #6,082,635 was granted on July 4, 2000; (3) Grants and proposals: The H U/ FM&AL was awarded the NASA grant NAG-3-2495 in October 2000 and the laboratory is a primary U.S. research team in a joint project under the CRDF award granted to the NASA GRC and IM/MSU (Russia) in July 2000; (4) Theory and numerical simulations: Analytical theory, numerical simulation, comparison of theoretical with experimental results, and modification of theoretical approaches, models, grids, etc., have been conducted for several complicated 2D and 3D nozzle and inlet designs using NASA, ICASE, and IM/MSU codes based on full Euler and Navier-Stokes solvers: CFL3D, FLUENT, and GODUNOV, and others; (5) Experimental Tests: (a) A new course: ”Advanced Aerodynamics and Aircraft Performance” presented in spring semester, 2001; training and experimental test research using the HU LSWT. (b) Small-scale M6bius-shaped screws were tested in different conditions and their application has shown essential benefits by comparison with traditional designs; (6) Installation in the FM&AL computer system: second software TECPLOT 8.0 for the UNIX SGI workstation and free TECPLOT 7.5 for the PC Dell computer, and 2D and 3D GRIDGEN (version 9) for the UNIX SGI as well as installation of two free NASA codes, 3D MAG and VULCAN; (7) Student Research Activity: Involvement of two undergraduate students as research assistants in the current research project.
Author
*Thrust; Rocket Engines; Aircraft Engines; Nozzle Design; Inlet Nozzles; Jet Aircraft Noise; Noise Reduction*

**20020019229** Thiokol Propulsion, Brigham City, UT USA
**Space Shuttle Reusable Solid Rocket Motor Program Overview and Lessons Learned**
Graves, Stan R., Thiokol Propulsion, USA; [2001]; 10p; In English; ASME Congress and Exposition, 11-16 Nov. 2001, New York, NY, USA; Sponsored by American Society of Mechanical Engineers, USA; Copyright; Avail: Issuing Activity

An overview of the Space Shuttle Reusable Solid Rocket Motor (RSRM) program is provided with a summary of lessons learned since the first test firing in 1977. Fifteen different lessons learned are discussed that fundamentally changed the motor’s design, processing, and RSRM program risk management systems. The evolution of the rocket motor design is presented

including the baseline or High Performance Solid Rocket Motor (HPM), the Filament Wound Case (FWC), the RSRM, and the proposed Five-Segment Booster (FSB).
Author
*Rocket Engine Design; Space Shuttle Boosters; Reusable Rocket Engines; Technology Utilization; Solid Propellant Rocket Engines*

**20020019962** Netherlands Energy Research Foundation, Petten, Netherlands
**Probability Distribution of Fatigue Strength of Rotor Blades (PROFAR): Publishable Final Report**
Braam, H.; van Delft, D. R. V.; Heijdra, J. J.; Jorgensen, E.; van Leeuwen, H.; Nov. 2001; 24p; In English
Report No.(s): PB2002-101665; ECN-C-01-116; Copyright; Avail: National Technical Information Service (NTIS), Microfiche
In the period June 1997-July 2001 the EU (European Union)-funded project 'Probability Distribution of Fatigue Strength of Rotor Blades-PROFAR' was carried out. The main objective of this project is to get a deeper understanding of the blade to blade variation of the fatigue strength of rotor blades and to determine the statistical distribution function by which this variation can be described. Furthermore the project aimed at the determination and quantification of the correlation between the measured fatigue strength of rotor blades and coupon data. to achieve the project objectives 37 small-scale blades have been tested both static and in fatigue. Next to these blades, a number of coupons of identical material as that of the blades has been tested statically and under fatigue loading. The tests served two main purposes, finding the scatter in the blade properties and relating the coupon test data to actual failure of real blades. In order to serve these purposes the two different sets of tests were done.
NTIS
*Turbine Blades; Fatigue (Materials); Rotor Blades (Turbomachinery)*

## 08
## AIRCRAFT STABILITY AND CONTROL

*Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also 05 Aircraft Design, Testing and Performance and 06 Avionics and Aircraft Instrumentation.*

**20020016302** BAE Systems, Melbourne, Australia
**Thrust Vector Control System Collaborative Multi-National Engineering Development for the Evolved Seasparrow Missile**
MacMaster, Jane, BAE Systems, Australia; MacLaren, Leon, BAE Systems, Australia; Yelland, Brad, BAE Systems, Australia; Facciano, Andrew, Raytheon Missile Systems Co., USA; Widmer, Dale, Raytheon Missile Systems Co., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 35-56; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche
Rapid response to a high-speed, low-altitude, incoming missile imposes very stringent design requirements upon an air-defence missile. A successful solution has been devised by using a Jet-Vane Control (JVC) concept for rapid launch maneuvering, minimising weight penalties by using actuation elements of other missile components and making the jet-vane assembly detachable. A JVC; System and method is illustrated for a surface air defence missile in which the system is compact, rugged, lightweight, and detachably connected to the aft end of a missile, adjacent to the rocket motor nozzle for the purpose of generating maneuvering forces from vanes inserted into the propellant stream. The JVC provides for very quick pitch over and roll control during shipboard vertical launch. The JVC then detaches from the missile and falls away so as not to degrade the rocket motor specific impulse during missile flight to target. There are four vanes mounted at right angles to each other, each having its own mounting support and gear train assembly. Each vane is connected through a detachable coupling to the Control Actuation Assembly (CAA) of the missile, such that actuation of the CAA simultaneously actuates the JVC System. The Evolved Sea Sparrow Missile (ESSM) Consortium primed by Raytheon Missile Systems (RMS), and partnered with BAE SYSTEMS Australia in the Control Section Integrated Product Team (IPT) successfully designed, analysed, prototype developed and flight tested a Thrust Vector Control (TVC) System, based on the JVC concept for immediate incorporation into the current Engineering Manufacturing Development (EMD) effort. Empirical test data collected was found to correlate well with the analytical techniques used to predict vane performance parameters. The resultant TVC System was proven to be robust and capable of meeting the ESSM operational requirements with margin.
Author
*Air Defense; Manufacturing; Missile Systems; Sparrow Missiles; Thrust Vector Control; Systems Engineering*

**20020018056** Colorado Univ., Center for Space Structures and Controls, Boulder, CO USA

**Real-Time Predictive Flutter Analysis and Continuous Parameter Identification of Acclerating Aircraft** ***Final Report, 15 Nov. 1998-14 Oct. 2000***

Farhat, Charbel; Oct. 14, 2000; 5p; In English

Contract(s)/Grant(s): F49620-99-1-0037

Report No.(s): AD-A396931; AFRL-SR-BL-TR-01-0606; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The present proposal requests high-end computer equipment to interface with and upgrade an existing parallel computing facility dedicated to the support of a Test & Evaluation research project currently funded by AFOSR, and conducted by three faculty, three graduate students, and two post-doctoral researchers at the Center for Aerospace Structures at the University 0 Colorado in Boulder, This research project pertains to the development of a real-time predictive flutter analysis capability, and the design of a continuous parameter identification method for extracting and monitoring the aeroelastie frequency and damping values of an accelerating fighter- An upgrade in processing power is requested to enable the continuation of this active and AFOSR funded research effort, as well as to support new Test & Evaluation research tasks that are currently being discussed with the Flight Test Center at the Edwards Air Force Base. The requested upgrade will transform the existing equipment into a high-end distributed computing platform that will remain dedicated to AFOSR Test & Evaluation research efforts. This new computational platform will accelerate the impact of our AFOSR funded research on the development of new aircraft such as the F22, the TSP, and the next generation UAVs. It will also enable the contribution of our research efforts to increasing flight safety during aggressive maneuvering, and reducing the number of flight test hours required for expanding the flutter envelope of current and next generation fighters.

DTIC

*Flight Tests; Parameter Identification; Aircraft Structures; Prediction Analysis Techniques; Maneuvers*

**20020018858** National Defence Research Establishment, Div. of Systems and Underwater Technology, Stockholm, Sweden

**Optimization of Missile Performance: Activity Report for Control Systems Design of Missile Systems** ***Optimering av Robotprestanda: Verksamhetsrapportering av Styrautomatutveckling foer Robotsystem***

Malmgren, A.; Dec. 1999; 15p; In Swedish

Report No.(s): PB2001-108090; FOA-R-99-01322-314-SE; No Copyright; Avail: National Technical Information Service (NTIS)

This report describes the activities during 1999 in the project 'Optimization of missile performance.' Anti-air missiles of tomorrow are advanced and high demands are put upon their control systems. A purpose of the project is to build up and spread knowledge of missiles and their control, guidance laws, and tools for simulation. The project intends to use modern control theory to develop tools that reduce the construction time of both the missile configurations and the control system. This is useful for assessment of missile systems. Recent gains in the area of non-linear systems can be used for studying how this can be utilized in order to enhance missile performance.

NTIS

*Construction; Control Systems Design; Missile Configurations; Missile Systems; Optimization*

**20020019083** Cranfield Univ., Flight Test and Dynamics Group, Cranfield, UK

**The Longitudinal Controls Fixed Static Stability of Tailless Aircraft**

deCastro, H. V., Cranfield Univ., UK; November 2000; 28p; In English

Report No.(s): COA-0018; ISBN 1-86194-072-6; Copyright; Avail: Issuing Activity

This paper describes the development of a simple theory of the longitudinal controls fixed static stability of tailless aeroplanes. The classical theory, as developed for the conventional aircraft, is modified to accommodate the particular features of the tailless aeroplanes. The theory was then applied to a particular blended-wing-body tailless civil transport aircraft, BWB-98.

Author

*Longitudinal Stability; Tailless Aircraft; Blended-Wing-Body Configurations*

## 09
## RESEARCH AND SUPPORT FACILITIES (AIR)

*Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see 03 Air Transportation and Safety. For astronautical facilities see 14 Ground Support Systems and Facilities (Space).*

**20020018870** NASA Ames Research Center, Moffett Field, CA USA
**The Unitary Plan Wind Tunnels**
Wedgworth, Kevin, NASA Ames Research Center, USA; Woo, Alex C., NASA Ames Research Center, USA; [1994]; 20p; In English
Contract(s)/Grant(s): RTOP 505-59-84; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Unitary Plan Facility is the most heavily used wind tunnel in all of NASA. Every major commercial transport and almost every fighter built in the USA over the last 30 years has been tested in this tunnel. Also tested in this tunnel complex were models of the Space Shuttle, as well as the Mercury, Gemini, and Apollo capsules. The wind tunnel represents a unique national asset of vital importance to the nation's defense and its competitive position in the world aerospace market. In 1985, the Unitary Plan Facility was named a National Historic Landmark by the National Park Service because of 'its significant associations with the development of the American Space Program.'
Author
*Aerospace Industry; Supersonic Wind Tunnels; Space Shuttles; Wind Tunnel Tests*

## 12
## ASTRONAUTICS (GENERAL)

*Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see categories 13 through 20. For extraterrestrial exploration, see 91 Lunar and Planetary Science and Exploration.*

**20020016715** NASA Marshall Space Flight Center, Huntsville, AL USA
**National Aeronautics and Space Administration Marshall Space Flight Center Space Transportation Directorate Risk Management Implementation Program**
Duarte, Luis Alberto, NASA Marshall Space Flight Center, USA; [2001]; 7p; In English; 22nd American Society of Engineering Management National Conference, 10-13 Oct. 2001, Huntsville, AL, USA; Sponsored by American Society for Engineering Management, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The US civil aerospace program has been a great contributor to the creation and implementation of techniques and methods to identify, analyze, and confront risk. NASA has accomplished mission success in many instances, but also has had many failures. Anomalies have kept the Agency from achieving success on other occasions, as well. While NASA has mastered ways to prevent risks, and to quickly and effectively react and recover from anomalies or failures, it was not until few years ago that a comprehensive Risk Management process started being implemented in some of its programs and projects. A Continuous Risk Management (CRM) cycle process was developed and has been promoted and used successfully in programs and projects across the Agency.
Derived from text
*NASA Programs; Risk; Project Management*

**20020018003** Origin B.V., Arnhem, Netherlands
**Advanced Crew Terminal, an Integrated, Common, Low Cost and Configurable Toolset for Operations Activities**
van Oijen, E. C.; Wolff, H. M.; Dujardin, P. G.; Oct. 12, 1999; 16p; In English; Original contains color illustrations
Report No.(s): PB2001-108841; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents the background to establishing the ACT, its capabilities and technology, latest results in MARES and other ongoing development and associated standardization activities for the International Space Station.
NTIS
*Computer Programs; Space Missions; Standardization*

**20020018051** Army Command and General Staff Coll., Fort Leavenworth, KS USA

**The Weaponization of Space: A Strategic Estimate**

Steele, Claire E.; Jun. 01, 2001; 82p; In English; Original contains color images

Report No.(s): AD-A396953; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The weaponization of space is a long debated topic. So far, space-based assets have not been targeted, although the technology exists to permit this kind of attack. The central research question is: Should the U.S. develop and employ space-based weapons? The nature of the threat leads the U.S. to three possible courses of action: keep space sanctuary, develop defensive weapons and measures only, or develop offensive and defensive weapons. Each course of action affects the U.S. national instruments of power: diplomatic, information, military, and economic, in different ways. The best course of action for the U. S. to take is to develop defensive weapons and measures only.

DTIC

*Economics; Warfare; Defense; Military Spacecraft*

**20020020427** NASA Marshall Space Flight Center, Huntsville, AL USA

**NASA Alternate Access to Station Service Concept**

Bailey, Michelle D., NASA Marshall Space Flight Center, USA; Crumbly, Chris, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; 53rd International Astronautical Congress Conference, 10-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The evolving nature of the NASA space enterprise compels the agency to develop new and innovative space systems concepts. NASA, working with increasingly strained budgets and a declining manpower base, is attempting to transform from operational activities to procurement of commercial services. NASA's current generation reusable launch vehicle, the Shuttle, is in transition from a government owned and operated entity to a commercial venture to reduce the civil servant necessities for that program. NASA foresees its second generation launch vehicles being designed and operated by industry for commercial and government services. The "service" concept is a pioneering effort by NASA. The purpose the "service" is not only to reduce the civil servant overhead but will free up government resources for further research - and enable industry to develop a space business case so that industry can sustain itself beyond government programs. In addition, NASA desires a decreased responsibility thereby decreasing liability. The Second Generation Reusable Launch Vehicle (RLV) program is implementing NASA's Space Launch Initiative (SLI) to enable industry to develop the launch vehicles of the future. The Alternate Access to Station (AAS) project office within this program is chartered with enabling industry to demonstrate an alternate access capability for the International Space Station (ISS). The project will not accomplish this by traditional government procurement methods, not by integrating the space system within the project office, or by providing the only source of business for the new capability. The project funds will ultimately be used to purchase a service to take re-supply cargo to the ISS, much the same as any business might purchase a service from FedEx to deliver a package to its customer. In the near term, the project will fund risk mitigation efforts for enabling technologies. AAS is in some ways a precursor to the 2nd Generation RLV. by accomplishing ISS resupply with existing technologies, not only will a new category of autonomous vehicles deliver cargo, but a commercial business base will be incubated that will improve the likelihood of commercial convergence with the next generation of RLVs. Traditional paradigms in government management and acquisition philosophy are being challenged in order to bring about the objective of the AAS project. The phased procurement approach is proving to be the most questionable aspect to date. This work addresses the fresh approach AAS is adopting in management and procurement through a study of the AAS history, current solutions, key technologies, procurement complications, and an incremental forward plan leading to the purchase of a service to deliver goods to ISS. Included in this work is a discussion of the Commercial Space Act of 1998 and how it affects government purchase of space launch and space vehicle services. Industry should find these topics pertinent to their current state of business.

Author

*Reusable Launch Vehicles; International Space Station; Space Commercialization*

**20020020455** Naval Postgraduate School, Monterey, CA USA

**Conceptual Design Tools for the NPS Spacecraft Design Center**

Abreu, Michael N.; Sep. 2001; 111p; In English; Original contains color images

Report No.(s): AD-A397230; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The thesis surveys and develops spacecraft design techniques and tools involving the integration of collaborative/concurrent engineering (CE) for spacecraft design, specifically in the areas of spreadsheet and CAD/CAE software, for the NPS Spacecraft Design Center (SDC). The applicability of solid modeling to the spacecraft design process is also explored. A previous class design is modeled using a solid modeling tool and the results compared against the time and effort required for the original. In addition, two CE software tools obtained from commercial and university sources are installed in the SDC, improved, documented if

necessary, and evaluated. The capabilities are evaluated with regard to learning curve, CE and their utility to the curriculum. A User's Guide for one of the software tools is written, as no documentation existed for it prior to this thesis. In addition, procedures for spacecraft design utilizing the SDC are developed in order to enhance student design capabilities and further their educational experience.
DTIC
*Spacecraft Design; Concurrent Engineering; Design Analysis; Education*

## 13
## ASTRODYNAMICS

*Includes powered and free-flight trajectories; and orbital and launching dynamics.*

**20020018563** Colorado Univ., Colorado Center for Astrodynamics Research, CO USA
**The Use of Eccentric and Circular Orbits in the Design of a Mars Network Constellation** ***Final Report***
Anderson, Rodney, Colorado Univ., USA; May 31, 2001; 15p; In English
Contract(s)/Grant(s): JPL-1215476; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This study examined different constellation configurations to determine their suitability for the Mars Network. Some variations on the baseline case of four circular orbits were initially studied. Eccentric orbits were then used to determine their effects on several figures of merit that were selected as representative of the design goals. It was eventually found that the use of eccentric orbits in combination with circular orbits can improve aspects of some navigation and communication figures of merit. The ability to use orbits at different inclinations helps smooth coverage over the middle and upper latitudes for these figures of merit. This configuration has more variability than one consisting of circular orbits, so the occurrence of unfavorable arrangements also results in degradation of some figures of merit. Some cases were used which improved different figures of merit, so a solution could be chosen depending on specified requirements.
Author
*Circular Orbits; Satellite Constellations; Eccentric Orbits; Configuration Management*

## 14
## GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

*Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also 09 Research and Support Facilities (Air).*

**20020018001** National Aerospace Lab., Amsterdam, Netherlands
**Concept for a Predictive Maintenance Facility for a Space Robot**
Bos, J. F. T.; Heemskerk, C.; Verhaegen, M.; Aug. 1999; 24p; In English
Report No.(s): PB2001-108844; NLR-TP-99341; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The purpose of the paper is to discuss predictive maintenance techniques based on signal analysis and analytical redundancy, to show what it would mean if they would be incorporated in the Ground Segment of a space robotic system, and to demonstrate the applicability of the techniques using a simplified model of a robotic joint.
NTIS
*Robotics; Prediction Analysis Techniques; Predictions*

## 15
## LAUNCH VEHICLES AND LAUNCH OPERATIONS

*Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also 18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.*

**20020016968** NASA Marshall Space Flight Center, Huntsville, AL USA
**Assessment and Accommodation of Thermal Expansion of the Internal Active Thermal Control System Coolant During Launch to On-Orbit Activation of International Space Station Elements**
Edwards, J. Darryl, Sverdrup Technology, Inc., USA; Ungar, Eugene K., NASA Johnson Space Center, USA; Holt, James M.,

NASA Marshall Space Flight Center, USA; [2001]; 23p; In English; Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The International Space Station (ISS) employs an Internal Active Thermal Control System (IATCS) comprised of several single-phase water coolant loops. These coolant loops are distributed throughout the ISS pressurized elements. The primary element coolant loops (i.e., US Laboratory module) contain a fluid accumulator to accommodate thermal expansion of the system. Other element coolant loops are parasitic (i.e., Airlock), have no accumulator, and require an alternative approach to insure that the system Maximum Design Pressure (MDP) is not exceeded during the Launch to Activation phase. During this time the element loop is a stand alone closed individual system. The solution approach for accommodating thermal expansion was affected by interactions of system components and their particular limitations. The mathematical solution approach was challenged by the presence of certain unknown or not readily obtainable physical and thermodynamic characteristics of some system components and processes. The purpose of this paper is to provide a brief description of a few of the solutions that evolved over time, a novel mathematical solution to eliminate some of the unknowns or derive the unknowns experimentally, and the testing and methods undertaken.

Author

*Accumulators; Coolants; Loops; Control Systems Design; Thermal Expansion*

**20020019803** Air War Coll., Maxwell AFB, AL USA

**Who Will Command the High Ground? The Case for a Separate Area of Responsibility for Space**

Morris, Mark A.; Apr. 1998; 60p; In English

Report No.(s): AD-A397222; AU/AWC/RWP182/98-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

From its inception in 1985, USA Space Command has been a functional combatant command. This served America well when US military space capabilities were in their relative infancy, and the primary mission of space forces was strategic warning through the ability to ”see” within the boundaries of sovereign nations. However, increasing capabilities, and the hard won lessons of the Persian Gulf War, made the US military aware of the vast potential for space-based and space-derived capabilities across the full spectrum of military operations. Indeed, the template for the future of the US military, Joint Vision 2010, with its tenets of dominant maneuver, precision engagement, full-dimensional protection, and focused logistics will be impossible to achieve without robust space capabilities and their significant force multiplying effects. But as the military dependence of space has increased dramatically, no US combatant command has been given responsibility for the region of space. Only by having a single commander leading an organization with the requisite expertise and resources for dealing with the unique responsibilities inherent to the region can the US military deal effectively with the challenges of space. This paper will examine the necessity of transitioning USSPACECOM to regional command status, responsible for the sixth area of responsibility, the region of space.

DTIC

*Military Operations; Aerospace Environments; Warfare; Armed Forces (USA)*

**20020020362** NASA Marshall Space Flight Center, Huntsville, AL USA

**Second Generation RLV Space Vehicle Concept**

Bailey, Michelle, NASA Marshall Space Flight Center, USA; Daniel, Charles, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; 53rd International Aeronautical Congress Conference, 10-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

NASA has a long history of conducting development programs and projects in a consistent fashion. Systems Engineering within those programs and projects has also followed a given method outlined by such documents as the NASA Systems Engineering Handbook. The relatively new NASA Space Launch Initiative (SLI) is taking a new approach to developing a space vehicle, with innovative management methods as well as new Systems Engineering processes. With the program less than a year into its life cycle, the efficacy of these new processes has yet to be proven or disproven. At $776M for phase 1, SLI represents a major portion of the NASA focus; however, the new processes being incorporated are not reflected in the training provided by NASA to its engineers. The NASA Academy of Program and Project Leadership (APPL) offers core classes in program and project management and systems engineering to NASA employees with the purpose of creating a ”knowledge community where ideas, skills, and experiences are exchanged to increase each other’s capacity for strong leadership”. The SLI program is, in one sense, a combination of a conceptual design program and a technology program. The program as a whole doesn’t map into the generic systems engineering project cycle as currently, and for some time, taught. For example, the NASA APPL Systems Engineering training course teaches that the ”first step in developing an architecture is to define the external boundaries of the system”, which will require definition of the interfaces with other systems and the next step will be to ”define all the components that make up the next lower level of the system hierarchy” where fundamental requirements are allocated to each component. Whereas, the SLI technology risk reduction approach develops architecture subsystem technologies prior to developing

architectures. The higher level architecture requirements are not allowed to fully develop and undergo decomposition and allocation down to the subsystems before the subsystems must develop allocated requirements based on the highest level of requirements. In the vernacular of the project cycles prior to the mid 1990's, the architecture definition portion of the program appears to be at a generic Phase A stage, while the subsystems are operating at Phase B. Even the management structure of the SLI program is innovative in its approach to Systems Engineering and is not reflected in the APPL training modules. The SLI program has established a Systems Engineering office as an office separate from the architecture development or the subsystem technology development, while that office does have representatives within these other offices. The distributed resources of the Systems Engineering Office are co-located with the respective Project Offices. This template is intended to provide systems engineering as an integrated function at the Program Level. the program management of SLI and the MAT agree that "program/project managers and the systems engineering team must work closely together towards the single objective of delivering quality products that meet the customer needs". This paper will explore the differences between the methods being taught by NASA, which represent decades of ideas, and those currently in practice in SLI. Time will tell if the innovation employed by SLI will prove to be the model of the future. For now, it is suggested that the training of the present exercise the flexibility of recognizing the new processes employed by a major new NASA program.
Author
*Reusable Launch Vehicles; Spacecraft Launching; Management Methods; Systems Engineering*

**20020020450** Air War Coll., Maxwell AFB, AL USA
**Increasing the Weaponization of Space: A Prescription for Further Progress**
Weidenheimer, Randall S.; Apr. 1998; 155p; In English
Report No.(s): AD-A397245; AU/AWC/246/1998-04; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This paper explores the impediments that prevent DOD from further developing space weapons and recommends actions DOD can take to mitigate/ eliminate these impediments. The history of space, and in particular space weapons, is addressed to eliminate likely incorrect impressions and lay the foundation for later discussions. Six major joint and AF future warfare reports/ studies (JV 2010, the Quadrennial Defense Review report, the National Defense Panel report, New World Vistas: Air and Space Power for the 21st Century', 2025, and Air and Space Power in the New Millennium are discussed in terms of their predictions for increasingly-important space activities in general and the value of space weapons in particular. Then a taxonomy for space weapons is developed, encompassing space control (satellite protection and negation) and force application (worldwide missile defense and worldwide precision strike). Five types of impediments (policy, strategy, legal, organizational, and feasibility) are then matched to the space weapon taxonomy, showing how various missions and weapon types/basing modes are effected. Finally, recommendations are made on how DOD can mitigate the impediments; these recommendations are assessed for the effort needed to accomplish them and brief statements are made on what DOD can do once the recommendations are implemented.
DTIC
*Space Weapons; Defense Program; Missile Defense; Taxonomy*

**20020020462** Air War Coll., Maxwell AFB, AL USA
**Can the U.S. Air Force Weaponize Space?**
McFaddin, David W.; Apr. 1998; 46p; In English
Report No.(s): AD-A397152; AU/AWC/RWP173/1998-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The US Air Force recently stated one of its core competencies is Air and Space Superiority control over what moves through air and space. Can the Air Force realistically achieve a level of Space Superiority, via weaponization, given international law, US National Space Policy, and politics? Or, given the Presidential veto of FY98 funds for Clementine II, Military Spaceplane, and Kinetic Energy Anti-Satellite (KE-ASAT), systems intended to support and enable Space Superiority, is the mention of Space Superiority merely rhetoric combined with wishful thinking? In trying to determine an answer to this question, several ideas for space control ranging from passive defense methods to active weaponization of space, such as a Space Based Laser (SBL), were considered. In the area of international law, both customary law and treaties were examined. The bottom line in this regard is the fact the United Nations Charter allows a country to defend itself and its property, even in space. On the other hand, the Anti Ballistic Missile (ABM) Treaty doesn't allow space based missile defenses. Finally, after examining several prospective space weaponization programs of interest to the Air Force, the common thread amongst the past and present politically acceptable programs is 'who wields the most power.' The only course the Air Force can take under the circumstances is to lean as far forward as possible with space weapon ideas while awaiting the political consensus to move ahead. This consensus could come from a proactive interpretation like used for Reagan's SDI, or a significant emotional event such as an attack on US satellites.
DTIC
*International Law; Space Law; Space Weapons*

## 16
## SPACE TRANSPORTATION AND SAFETY

*Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also 03 Air Transportation and Safety and 15 Launch Vehicles and Launch Vehicles, and 18 Spacecraft Design, Testing and Performance. For space suits, see 54 Man/System Technology and Life Support.*

**20020018902** NASA Glenn Research Center, Cleveland, OH USA

**An Algorithm for Interactive Modeling of Space-Transportation Engine Simulations: A Constraint Satisfaction Approach**

Mitra, Debasis, Jackson State Univ., USA; Thomas, Ajai, Jackson State Univ., USA; Hemminger, Joseph, NASA Glenn Research Center, USA; Sakowski, Barbara, NASA Glenn Research Center, USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 29; In English; Also announced as 20020018881

Report No.(s): P21; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In this research we have developed an algorithm for the purpose of constraint processing by utilizing relational algebraic operators. Van Beek and others have investigated in the past this type of constraint processing from within a relational algebraic framework, producing some unique results. Apart from providing new theoretical angles, this approach also gives the opportunity to use the existing efficient implementations of relational database management systems as the underlying data structures for any relevant algorithm. Our algorithm here enhances that framework. The algorithm is quite general in its current form. Weak heuristics (like forward checking) developed within the Constraint-satisfaction problem (CSP) area could be also plugged easily within this algorithm for further enhancements of efficiency. The algorithm as developed here is targeted toward a component-oriented modeling problem that we are currently working on, namely, the problem of interactive modeling for batch-simulation of engineering systems (IMBSES). However, it could be adopted for many other CSP problems as well. The research addresses the algorithm and many aspects of the problem IMBSES that we are currently handling.

Author

*Algorithms; Space Transportation; Computerized Simulation; Constraints*

**20020020364** NASA Marshall Space Flight Center, Huntsville, AL USA

**Environmentally Compatible Vapor-Phase Corrosion Inhibitor for Space Shuttle Hardware**

Novak, Howard L., United Space Alliance, USA; Hall, Phillip B., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; 5th AMPET Conference, 16-18 Sep. 2002, Huntsville, AL, USA; No Copyright; Avail: Issuing Activity; Abstract Only

USA-SRB Element is responsible for the assembly and refurbishment of the non-motor components of the SRB as part of Space Shuttle. Thrust Vector Control (TVC) frames structurally support components of the TVC system located in the aft skirt of the SRB. TVC frames are exposed to the seacoast environment after refurbishment and, also, to seawater immersion after splashdown, and during tow-back to CCAFS-Hangar AF refurbishment facilities. During refurbishment operations it was found that numerous TVC frames were experiencing internal corrosion and coating failures, both from salt air and seawater intrusions. Inspectors using borescopes would visually examine the internal cavities of the complicated aluminum alloy welded tubular structure. It was very difficult for inspectors to examine cavity corners and tubing intersections and particularly, to determine the extent of the corrosion and coating anomalies. Physical access to TVC frame internal cavities for corrosion removal and coating repair was virtually impossible, and an improved method using a Liquid (water based) Vapor-phase Corrosion Inhibitor (LVCI) for preventing initiation of new corrosion, and mitigating and/or stopping existing corrosion growth was recommended in lieu of hazardous paint solvents and high VOC/solvent based corrosion inhibitors. In addition, the borescopic inspection method used to detect corrosion, and/or coating anomalies had severe limitations because of part geometry, and an improved non-destructive inspection (NDI) method using Neutron Radiography (N-Ray) was also recommended.

Author

*Vapor Phases; Corrosion Prevention; Space Shuttles; Sea Water; Welded Structures*

## 17
## SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

*Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information, see also 04 Aircraft Communications and Navigation and 32 Communications and Radar.*

**20020016701** Department of Energy, Region VII, Kansas City, MO USA
**Mechanical, Electrical, and Environmental Evaluation of Nano-Miniature Connectors**
Hilton, J. W.; Jul. 30, 2001; 41p; In English
Report No.(s): DE2001-783946; KCP-613-6453; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Because of their small size (0.025-inch spacing), nano-miniature connectors have been chosen for JTA telemetry applications. At the time they were chosen, extensive testing had not been done to determine the mechanical, electrical, and environmental characteristics of these connectors at the levels required for use by weapon systems. Since nano-miniature connectors use some unique plating and wire crimping processes not used in most design agency connectors, it was decided that these properties should be tested thoroughly. This report describes the results of that testing.
NTIS
*Connectors; Miniaturization; Weapon Systems*

**20020018055** Range Commanders Council, Telemetry Group, White Sands Missile Range, NM USA
**Telemetry Standards**
Feb. 2001; 387p; In English
Report No.(s): AD-A396935; IRIG-STANDARD-106-01-PT-1; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

The Telemetry Standards have taken on a new look effective with this release. The IRIG-106 is now published in two parts. Part I contains the more familiar information and standards that have been evolved over the years. Part II is a totally new entity. This new part is devoted to the standards associated with the present technological evolution I revolution in the telemetry networks area.
DTIC
*Radio Telemetry; Telemetry*

## 18
## SPACECRAFT DESIGN, TESTING AND PERFORMANCE

*Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems, see 54 Man/System Technology and Life Support. For related information, see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation and Safety.*

**20020016726** NASA Marshall Space Flight Center, Huntsville, AL USA
**Flux Compression Magnetic Nozzle**
Thio, Y. C. Francis, NASA Marshall Space Flight Center, USA; [2001]; 4p; In English; AIAA Joint Propulsion Conference, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

In pulsed fusion propulsion schemes in which the fusion energy creates a radially expanding plasma, a magnetic nozzle is required to redirect the radially diverging flow of the expanding fusion plasma into a rearward axial flow, thereby producing a forward axial impulse to the vehicle. In a highly electrically conducting plasma, the presence of a magnetic field B in the plasma creates a pressure B(exp 2)/2(mu) in the plasma, the magnetic pressure. A gradient in the magnetic pressure can be used to decelerate the plasma traveling in the direction of increasing magnetic field, or to accelerate a plasma from rest in the direction of decreasing magnetic pressure. In principle, ignoring dissipative processes, it is possible to design magnetic configurations to produce an 'elastic' deflection of a plasma beam. In particular, it is conceivable that, by an appropriate arrangement of a set of coils, a good approximation to a parabolic 'magnetic mirror' may be formed, such that a beam of charged particles emanating from the focal point of the parabolic mirror would be reflected by the mirror to travel axially away from the mirror. The degree to which this may be accomplished depends on the degree of control one has over the flux surface of the magnetic field, which changes as a result of its interaction with a moving plasma.
Derived from text
*Fusion Propulsion; Magnetic Fields; Plasmas (Physics); Magnetic Nozzles; Magnetohydrodynamic Flow*

**20020016969** NASA Marshall Space Flight Center, Huntsville, AL USA

**X-38 De-Orbit Propulsion Stage MLI Performance Test**

Kittredge, Ken, NASA Marshall Space Flight Center, USA; [2001]; 15p; In English; Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This viewgraph presentation gives an overview of the X-38 de-orbit propulsion stage MLI performance tests. The objectives of the research include the testing of the deorbit propulsion stage (DPS) multi-layer insulation (MLI) to determine if MLI performance meets or exceeds that assumed in thermal analysis and to determine the performance degradation due to seams.

CASI

*Multilayer Insulation; Performance Tests; Thermal Analysis; X-38 Crew Return Vehicle*

**20020017414** Aerospace Corp., Lab. Operations, El Segundo, CA USA

**Radiation Environment Predictions for Laboratory Tests**

Meshishnek, M. J.; Stuckery, W. K.; Anderson, P. C.; Oct. 01, 2001; 16p; In English

Contract(s)/Grant(s): F04701-00-C-0009

Report No.(s): AD-A396828; TR-2001(8565)-9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Long-duration space environment exposure tests are performed to examine effects that might occur with materials exposed on external spacecraft surfaces. To properly simulate the orbital environment, information regarding the charged-particle environment is required. Once the orbital environment is known and tabulated, an energy deposition code is used to calculate energy dose depth profiles in selected materials for the electron and proton fluences during the mission. These are then simulated using a series of monoenergetic species that together sum up to a close approximation of the orbital dose profile. The specific information needed for the environment in a particular orbit is the flux of the radiation as a function of energy. This information is generally available from upper-atmosphere models such as AE8 and AP8; however, these models are deficient at lower particle energies, resulting in under-prediction of the surface fluence. In this report, a method to predict a suitable radiation environment for laboratory simulations of a LEO orbit is described.

DTIC

*Radiation; Predictions; Charged Particles; Environmental Tests; Aerospace Environments; Energy Transfer*

**20020018000** National Aerospace Lab., Amsterdam, Netherlands

**Preparing for Liquid Motion Experiments in Space: Sloshsat Mini-Spacecraft Dynamics and Control**

Vreeburg, J. P. B.; van Woerkom, P. T. L. M.; Feb. 2000; 18p; In English

Report No.(s): PB2001-108846; NLR-TP-99570; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Modern spacecraft tend to contain increasingly large volumes of liquids. Adequate understanding of the interaction between spacecraft dynamics and liquid dynamics is necessary for the realization of the required mission performance. This paper discusses the necessity of inorbit experiments and sketches the Sloshsat mini-spacecraft testbed that is currently under development.

NTIS

*Liquid Sloshing; Spacecraft Maneuvers; Spacecraft Control*

**20020018564** Colorado Univ., Colorado Center for Astrodynamics Research, CO USA

**Radiation Pressure Forces, the Anomalous Acceleration, and Center of Mass Motion for the TOPEX/POSEIDON Spacecraft *Final Report***

Kubitschek, Daniel G., Colorado Univ., USA; Born, George H., Colorado Univ., USA; Sep. 30, 2000; 18p; In English

Contract(s)/Grant(s): JPL-1214025; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Shortly after launch of the TOPEX/POSEIDON (T/P) spacecraft (s/c), the Precision Orbit Determination (POD) Team at NASA's Goddard Space Flight Center (GSFC) and the Center for Space Research at the University of Texas, discovered residual along-track accelerations, which were unexpected. Here, we describe the analysis of radiation pressure forces acting on the T/P s/c for the purpose of understanding and providing an explanation for the anomalous accelerations. The radiation forces acting on the T/P solar army, which experiences warping due to temperature gradients between the front and back surfaces, are analyzed and the resulting along-track accelerations are determined. Characteristics similar to those of the anomalous acceleration are seen. This analysis led to the development of a new radiation form model, which includes solar array warping and a solar array deployment deflection of as large as 2 deg. As a result of this new model estimates of the empirical along-track acceleration are reduced in magnitude when compared to the GSFC tuned macromodel and are less dependent upon beta(prime), the location of the Sun relative to the orbit plane. If these results we believed to reflect the actual orientation of the T/P solar array then motion of the solar array must influence the location of the s/c center of mass. Preliminary estimates indicate that the center of mass can

vary by as much as 3 cm in the radial component of the s/c's position due to rotation of the deflected, warped solar array panel .The altimeter measurements rely upon accurate knowledge of the center of mass location relative to the s/c frame of reference. Any radial motion of the center of mass directly affects the altimeter measurements.
Author
*Deflection; Poseidon Satellite; Position (Location); Radiation Pressure; Solar Arrays; TOPEX; Acceleration (Physics)*

## 20
## SPACECRAFT PROPULSION AND POWER

*Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also 07 Aircraft Propulsion and Power; 28 Propellants and Fuels; 15 Launch Vehicles and Launch Operations; and 44 Energy Production and Conversion.*

**20020016285** Princeton Univ., Plasma Physics Lab., NJ USA
**Toroidal Plasma Thruster for Interplanetary and Interstellar Space Flights**
Gorelenkov, N. N.; Zakharov, L. E.; Gorelenkova, M. V.; Jul. 11, 2001; 34p; In English
Report No.(s): DE2001-787785; PPPL-3592; No Copyright; Avail: Department of Energy Information Bridge
This work involves a conceptual assessment for using the toroidal fusion reactor for deep space interplanetary and interstellar missions. Toroidal thermonuclear fusion reactors, such as tokamaks and stellarators, are unique for space propulsion, allowing for a design with the magnetic configuration localized inside toroidal magnetic field coils. Plasma energetic ions, including charged fusion products, can escape such a closed configuration at certain conditions, a result of the vertical drift in toroidal rippled magnetic field. Escaping particles can be used for direct propulsion (since toroidal drift is directed one way vertically) or to create and heat externally confined plasma, so that the latter can be used for propulsion.Deuterium-tritium fusion neutrons with an energy of 14.1 MeV also can be used for direct propulsion. A special design allows neutrons to escape the shield and the blanket of the tokamak. This provides a direct (partial) conversion of the fusion energy into the directed motion of the propellant. In contrast to other fusion concepts proposed for space propulsion, this concept utilizes the natural drift motion of charged particles out of the closed magnetic field configuration.
NTIS
*Plasma Engines; Toroidal Plasmas; Space Flight; Thrustors*

**20020016300** Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
**50th JANNAF Propulsion Meeting, Volume 1**
Eggleston, Debra S., Editor, Johns Hopkins Univ., USA; July 2001; 498p; In English; 50th JANNAF Propulsion Meeting, 11-13 Jul. 2001, Salt Lake City, UT, USA; Sponsored by Department of the Army, USA; Also announced as 20020016301 through 20020016328
Contract(s)/Grant(s): SPO700-97-D-4004
Report No.(s): CPIA-Publ-705-Vol-1; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche
This volume, the first of two volumes, is a collection of 29 unclassified/unlimited-distribution papers which were presented at the 50th Joint Army-Navy-NASA-Air Force (JANNAF) Propulsion Meeting, held 11-13 July 2001 at the Salt Lake City Marriott Hotel in Salt Lake City, Utah.
Author
*Conferences; Chemical Propulsion; Air Breathing Engines; Thermochemistry; Missiles; Explosives; Pulse Detonation Engines*

**20020016312** Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
**Evaluation of Methods Used within the NATO Propulsion Community to Measure and Use Burning Rate in Solid Propellant Rocket Systems**
Fry, R. S., Johns Hopkins Univ., USA; DeLuca, L., Politecnico di Milano, Italy; Frederick, R., Alabama Univ., USA; Gadiot, G., Prins Maurits Lab. TNO, Netherlands; Strecker, R., Bayern-Chemie G.m.b.H., Germany; Besser, H.-L., Bayern-Chemie G.m.b.H., Germany; Whitehouse, A., RO Defence rocket Motors, UK; Traineau, J.-C., Office National d'Etudes et de Recherches Aerospatiales, France; Ribereau, D., Societe Nationale des Poudres et Explosifs, France; Reynaud, J.-P., Societe Nationale des Poudres et Explosifs, France; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 221-238; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche
The NATO Research and Technology Organization (RTO), Advanced Vehicle Technology (AVT), Working Group (WG) 016 (formerly AGARD/PEP Working Group #27) undertook to evaluate methods used within the NATO propulsion community to

measure burning rate in solid propellant rocket systems. The purpose was to identify similarities and differences among the member nations. The WG 016 sought to contribute to improvements in the burning rate tools by addressing issues that have remained unresolved in the solid propulsion industry for over 40 years: 1) Better understanding of burning rate, rb(p,To), data from various facilities. 2) Improved measurement accuracy and reliability for greater test efficiencies. AVT WG 016 was formed in 1996, consisting of representatives from 6 of the 15 member nations of NATO, with inputs accepted from four other member nations and two non-member nations. This work was recently completed and a final report prepared. This paper represents the first release of the results of this study within the US, and summarizes the objectives, approach, findings, and recommendations of this working group based on activity from October 1997 to March 2001. Recommendations are reviewed on direct and non-intrusive burning rate measurement methods, data analysis methods, and performance scaling to support improved prediction of internal ballistics of a full-scale solid propellant motor. AVT WG 016 activities have identified that manufacturer burning rate data may not easily be compared without accounting for industry-wide differences in subscale devices, test methods and scaling analysis methods. The WG recommends the NATO propulsion community review these findings as a means of advancing their own burning rate measurement and analysis methods.
Author

*Burning Rate; North Atlantic Treaty Organization (NATO); Solid Propellant Rocket Engines; Propulsion System Performance*

**20020016325** NASA Marshall Space Flight Center, Huntsville, AL USA

**Thermal Fault Tolerance Analysis of a Carbon Fiber Rope Barrier for Use in the Reusable Solid Rocket Motor Nozzle Joint-2**

Clayton, J. Louie, NASA Marshall Space Flight Center, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 407-416; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

This study provides for development and verification of analysis methods used to assess performance of a carbon fiber rope (CFR) thermal barrier system for use in Reusable Solid Rocket Motor (RSRM) nozzle joint-2. First, a model is developed and calibrated for a baseline ”no-defect” geometry where flow into the joint is controlled by two CFRs placed in an open assembly gap. For thermal fault tolerance analysis, spice defects are assumed to preexist in the CFRs providing a direct gas path to the joint structural housing. Simulation methodology is based on a volume filling approach where flow resistances (gap, CFRs and splice defect) are defined by internal flow and porous media relationships. Combustion gas flow rates are computed using a volume filling code assuming a lumped distribution total joint volume. Gas-to-wall heat transfer is simulated by concurrent solution of the compressible flow equations and a large thermal 2-D finite element (FE) conduction grid. Fault tolerance modeling includes a FE sub-model approach where heat transfer computations are resolved on a detail grid of the CFR defect and flow impingement region. The sub-model solves concurrently with the global model aiding in the determination overall pressurization rate of the joint free volume. The model was used to make full-scale motor predictions using RSRM aft dome environments. Results indicate that baseline CFR barrier systems provide a thermally benign pressurization environment for primary seal activation. Worst-case CFR thermal fault tolerance results indicate potential for minor heat affects to housing painted surfaces and phenolics.
Author

*Carbon Fibers; Fault Tolerance; Solid Propellant Rocket Engines; Mathematical Models; Computational Grids; Rocket Nozzles*

**20020016326** Astro Technology, Inc., Houston, TX USA

**Fiber-Optic Sensor Technology for Solid Rocket Motor Components**

Brower, David V., Astro Technology, Inc., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 417-424; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Fiber-optic sensors offer many advantages over conventional sensors when used to measure solid rocket motor properties. Several fiber-optic sensor configurations have been investigated as a means to provide data for solid rocket motors. They are ideally suited to solid rocket motor applications for several reasons: (1) they use no electric current and are inherently safe, (2) they are immune to electromagnetic interference, (3) they are highly accurate, (4) large numbers of sensors can be multiplexed along a single fiber-optic strand, (5) they are extremely small and non-intrusive. The sensors are capable of measuring strain, temperature, pressure and vibration. They are suited for usage on case material, nozzles, and bonded interfaces and can be bonded to the exterior or cast in-situ. A specially configured high elongation fiber-optic sensor is capable of measuring high strains in propellant. Structural data has been obtained from solid rocket motor testing with inert propellant samples, bonded interfaces and composite case materials. Good correlation exists between fiber-optic sensor data and that obtained from conventional sensors.
Author

*Fiber Optics; Solid Propellant Rocket Engines; Sensors; Solid Rocket Propellants; Fabry-Perot Interferometers*

**20020016328** Army Tank-Automotive and Armaments Command, Picatinny Arsenal, NJ USA

**Accelerated Testing of M549A1 Rocket Motors**

Bixon, Eric R., Army Tank-Automotive and Armaments Command, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 461-469; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper addresses the degradation behavior of AHH propellant, which is cast into rocket motors for use in the M549A1 Rocket Assisted Projectile. A study on the stabilizer depletion rates that occur in small samples taken from an M549 rocket grain has been conducted. Reaction kinetic models have been formulated to describe the reaction of 2NDPA and the formation of some of its derivatives. Data obtained from the experiment have been correlated. The models have been developed as part of a larger effort to characterize the degradation behavior of the propellant and to provide stability data at elevated temperatures.
Author

*Accelerated Life Tests; Explosives; Reaction Kinetics; Mathematical Models; Nitrogen Compounds; Propellant Grains; Solid Rocket Propellants*

**20020016608** Boeing Co., Rocketdyne Propulsion and Power, Canoga Park, CA USA

**Rocket-Based Combined Cycle Engine Concept Development**

Ratekin, G., Boeing Co., USA; Goldman, Allen, Boeing Co., USA; Ortwerth, P., Boeing Co., USA; Weisberg, S., Boeing Co., USA; [2001]; 35p; In English

Contract(s)/Grant(s): NAS8-40864; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The development of rocket-based combined cycle (RBCC) propulsion systems is part of a 12 year effort under both company funding and contract work. The concept is a fixed geometry integrated rocket, ramjet, scramjet, which is hydrogen fueled and uses hydrogen regenerative cooling. The baseline engine structural configuration uses an integral structure that eliminates panel seals, seal purge gas, and closeout side attachments. Engine A5 is the current configuration for NASA Marshall Space Flight Center (MSFC) for the ART program. Engine A5 models the complete flight engine flowpath of inlet, isolator, airbreathing combustor, and nozzle. High-performance rocket thrusters are integrated into the engine enabling both low speed air-augmented rocket (AAR) and high speed pure rocket operation. Engine A5 was tested in GASL's new Flight Acceleration Simulation Test (FAST) facility in all four operating modes, AAR, RAM, SCRAM, and Rocket. Additionally, transition from AAR to RAM and RAM to SCRAM was also demonstrated. Measured performance demonstrated vision vehicle performance levels for Mach 3 AAR operation and ramjet operation from Mach 3 to 4. SCRAM and rocket mode performance was above predictions. For the first time, testing also demonstrated transition between operating modes.
Author

*Engine Design; Propulsion System Configurations; Structural Analysis; Performance Tests*

**20020016609** NASA Marshall Space Flight Center, Huntsville, AL USA

**Temperature Dependent Modal Test/Analysis Correlation of X-34 Fastrac Composite Rocket Nozzle**

Brown, Andrew M., NASA Marshall Space Flight Center, USA; [2001]; 23p; In English; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-1741; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A unique high temperature modal test and model correlation/update program has been performed on the composite nozzle of the FASTRAC engine for the NASA X-34 Reusable Launch Vehicle. The program was required to provide an accurate high temperature model of the nozzle for incorporation into the engine system structural dynamics model for loads calculation; this model is significantly different from the ambient case due to the large decrease in composite stiffness properties due to heating. The high-temperature modal test was performed during a hot-fire test of the nozzle. Previously, a series of high fidelity modal tests and finite element model correlation of the nozzle in a free-free configuration had been performed. This model was then attached to a modal-test verified model of the engine hot-fire test stand and the ambient system mode shapes were identified. A reduced set of accelerometers was then attached to the nozzle, the engine fired full-duration, and the frequency peaks corresponding to the ambient nozzle modes individually isolated and tracked as they decreased during the test. to update the finite-element model of the nozzle to these frequency curves, the percentage differences of the anisotropic composite moduli due to temperature variation from ambient, which had been used in the initial modeling and which were obtained by small sample coupon testing, were multiplied by an iteratively determined constant factor. These new properties were used to create high-temperature nozzle models corresponding to 10 second engine operation increments and tied into the engine system model for loads determination.
Author

*High Temperature Tests; Rocket Nozzles; Data Correlation; Mathematical Models*

**20020016709** NASA Marshall Space Flight Center, Huntsville, AL USA

**Development of a Gas-Fed Pulse Detonation Research Engine**

Litchford, Ron J., NASA Marshall Space Flight Center, USA; December 2001; 46p; In English

Report No.(s): NASA/TP-2001-211412; M-1036; NAS 1.60:211412; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In response to the growing need for empirical data on pulse detonation engine performance and operation, NASA Marshall Space Flight Center has developed and placed into operation a low-cost gas-fed pulse detonation research engine. The guiding design strategy was to achieve a simple and flexible research apparatus, which was inexpensive to build and operate. As such, the engine was designed to operate as a heat sink device, and testing was limited to burst-mode operation with run durations of a few seconds. Wherever possible, maximum use was made of standard off-the-shelf industrial or automotive components. The 5-cm diameter primary tube is about 90-cm long and has been outfitted with a multitude of sensor and optical ports. The primary tube is fed by a coaxial injector through an initiator tube, which is inserted directly into the injector head face. Four auxiliary coaxial injectors are also integrated into the injector head assembly. All propellant flow is controlled with industrial solenoid valves. An automotive electronic ignition system was adapted for use, and spark plugs are mounted in both tubes so that a variety of ignition schemes can be examined. A microprocessor-based fiber-optic engine control system was developed to provide precise control over valve and ignition timing. Initial shakedown testing with hydrogen/oxygen mixtures verified the need for Schelkin spirals in both the initiator and primary tubes to ensure rapid development of the detonation wave. Measured pressure wave time-of-flight indicated detonation velocities of 2.4 km/sec and 2.2 km/sec in the initiator and primary tubes, respectively. These values implied a fuel-lean mixture corresponding to an H2 volume fraction near 0.5. The axial distribution for the detonation velocity was found to be essentially constant along the primary tube. Time-resolved thrust profiles were also acquired for both underfilled and overfilled tube conditions. These profiles are consistent with previous time-resolved measurements on single-cycle tubes where the thrust is found to peak as the detonation wave exits the tube, and decay as the tube blows down.
Author

*Solenoid Valves; Automobiles; Pulse Detonation Engines; Fiber Optics; Microprocessors; Gas Dynamics*

**20020016716** NASA Marshall Space Flight Center, Huntsville, AL USA

**Overview of Rotating Cavitation and Cavitation Surge in the Fastrac Engine LOX Turbopump**

Zoladz, Thomas, NASA Marshall Space Flight Center, USA; [2001]; 6p; In English; First International Symposium on Advanced Fluids Information, 4-5 Oct. 2001, Sendai, Japan; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Observations regarding rotating cavitation and cavitation surge experienced during the development of the Fastrac 60 Klbf engine turbopump are discussed. Detailed observations from the analysis of both water flow and liquid oxygen test data are offered. Scaling and general comparison of rotating cavitation between water flow and liquid oxygen testing are discussed. Complex data features linking the localized rotating cavitation mechanism of the inducer to system surge components are described in detail. Finally a description of a simple lumped-parameter hydraulic system model developed to better understand observed data is given.
Author

*Cavitation Flow; Lumped Parameter Systems; Rotation; Surges; Turbine Pumps*

**20020016717** NASA Marshall Space Flight Center, Huntsville, AL USA

**Development and Validation of High Performance Unshrouded Centrifugal Impeller**

Chen, Wei-Chung, Boeing Co., USA; Williams, M., Boeing Co., USA; Paris, John K., Boeing Co., USA; Prueger, G. H., Boeing Co., USA; Williams, Robert, NASA Marshall Space Flight Center, USA; [2001]; 8p; In English; 37th AIAA/ASME/ASEE Joint Propulsion Conference, Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS8-985259; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The feasibility of using a two-stage unshrouded impeller turbopump to replace the current three-stage reusable launch vehicle engine shrouded impeller hydrogen pump has been evaluated from the standpoint of turbopump weight reduction and overall payload improvement. These advantages are a by-product of the higher tip speeds that an unshrouded impeller can sustain. The issues associated with the effect of unshrouded impeller tip clearance on pump efficiency and head have been evaluated with one-dimensional tools and full three-dimensional rotordynamic fluid reaction forces and coefficients have been established through time dependent computational fluid dynamics (CFD) simulation of the whole 360 degree impeller with different rotor eccentricities and whirling ratios. Unlike the shrouded impeller, the unshrouded impeller forces are evaluated as the sum of the pressure forces on the blade and the pressure forces on the hub using the CFD results. The turbopump axial thrust control has been optimized by adjusting the first stage impeller backend wear ring seal diameter and diverting the second stage backend balance piston flow to the proper location. The structural integrity associated with the high tip speed has been checked by analyzing a

3D-Finite Element Model at maximum design conditions (6% higher than the design speed). This impeller was fabricated and tested in the NASA Marshall Space Flight Center water-test rig. The experimental data will be compared with the analytical predictions and presented in another paper. The experimental data provides validation data for the numerical design and analysis methodology. The validated numerical methodology can be used to help design different unshrouded impeller configurations.
Author
*Computational Fluid Dynamics; Pump Impellers; Computerized Simulation; Feasibility Analysis*

**20020016724** NASA Marshall Space Flight Center, Huntsville, AL USA
**Thermal Analysis in Support of the Booster Separation Motor Crack Investigation**
Davis, Darrell, NASA Marshall Space Flight Center, USA; Prickett, Terry, NASA Marshall Space Flight Center, USA; [2001]; 13p; In English; 2001 Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During a post-test inspection of a Booster Separation Motor (BSM) from a Lot Acceptance Test (LAT), a crack was noticed in the graphite throat. Since this was an out-of-family occurrence, an investigation team was formed to determine the cause of the crack. This paper will describe thermal analysis techniques used in support of this investigation. Models were generated to predict gradients in nominal motor conditions, as well as potentially anomalous conditions. Analysis was also performed on throats that were tested in the Laser Hardened Material Evaluation Laboratory (LHMEL). Some of these throats were pre-cracked, while others represented configurations designed to amplify effects of thermal stresses. Results from these analyses will be presented in this paper.
Author
*Surface Cracks; Thermal Analysis; Throats; Computerized Simulation*

**20020016725** NASA Marshall Space Flight Center, Huntsville, AL USA
**A Summary of the NASA Fusion Propulsion Workshop 2000**
Thio, Y. C. Francis, NASA Marshall Space Flight Center, USA; Turchi, Peter J., Los Alamos National Lab., USA; Santarius, John F., Wisconsin Univ., USA; [2001]; 2p; In English; AIAA Joint Propulsion Conference, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A NASA Fusion Propulsion Workshop was held on Nov. 8 and 9, 2000 at Marshall Space Flight Center (MSFC) in Huntsville, Alabama. A total of 43 papers were presented at the Workshop orally or by posters, covering a broad spectrum of issues related to applying fusion to propulsion. The status of fusion research was reported at the Workshop showing the outstanding scientific research that has been accomplished worldwide in the fusion energy research program. The international fusion research community has demonstrated the scientific principles of fusion creating plasmas with conditions for fusion burn with a gain of order unity: 0.25 in Princeton TFTR, 0.65 in the Joint European Torus, and a Q-equivalent of 1.25 in Japan's JT-60. This research has developed an impressive range of physics and technological capabilities that may be applied effectively to the research of possibly new propulsion-oriented fusion schemes. The pertinent physics capabilities include the plasma computational tools, the experimental plasma facilities, the diagnostics techniques, and the theoretical understanding. The enabling technologies include the various plasma heating, acceleration, and the pulsed power technologies.
Derived from text
*Energy Technology; Fusion Propulsion; Plasmas (Physics); Conferences; Research and Development*

**20020017266** NASA Marshall Space Flight Center, Huntsville, AL USA
**Elimination of Intermediate-Frequency Combustion Instability in the Fastrac Engine Thrust Chamber**
Rocker, Marvin, NASA Marshall Space Flight Center, USA; Nesman, Tomas E., NASA Marshall Space Flight Center, USA; [2001]; 15p; In English; Pennsylvania State Univ. Propulsion Research Center 13th Annual Symposium on Propulsion, 22-23 Oct. 2001, Huntsville, AL, USA; Sponsored by Pennsylvania State Univ., USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of tests were conducted to measure the combustion performance of the Fastrac engine thrust chamber. The thrust chamber exhibited benign, yet marginally unstable combustion. The marginally unstable combustion was characterized by chamber pressure oscillations with large amplitudes and a frequency that was too low to be identified as acoustic or high-frequency combustion instability and too high to be identified as chug or low-frequency combustion instability. The source of the buzz or intermediate-frequency combustion instability was traced to the fuel venturi whose violently noisy cavitation caused resonance

in the feedline downstream. Combustion was stabilized by increasing the throat diameter of the fuel venturi such that the cavitation would occur more quietly.
Author
*Cavitation Flow; Combustion Stability; Intermediate Frequencies; Thrust Chambers; Ground Tests*

**20020017518** ATK-Thiokol Propulsion, Brigham City, UT USA
**Development and Sub-Scale Testing of a Gas Generating Solid Fuel Hybrid Rocket Motor with Oxygen and Hydrogen Peroxide**
Lund, Gary K., ATK-Thiokol Propulsion, USA; Starrett, William David, ATK-Thiokol Propulsion, USA; Jensen, Kent C., ATK-Thiokol Propulsion, USA; [2001]; 9p; In English; 50th JANNAF Propulsion Meeting, 12-13 Jul. 2001, Salt Lake City, UT, USA; Sponsored by NASA, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS8-00138; Copyright; Avail: Issuing Activity

As part of a NASA funded contract to develop and demonstrate a gas generator cycle hybrid rocket motor for upper stage space motor applications, the development and demonstration of a low sensitivity, high performance fuel composition was undertaken. The ultimate goal of the development program was to demonstrate successful hybrid operation (start, stop, throttling) of the fuel with high concentration (90+%) hydrogen peroxide. The formulation development and sub-scale testing of a simple DOT Class 1.4c gas generator propellant is described. Both forward injected center perforated and aft injected end burner hybrid combustion behavior were evaluated with gaseous oxygen and catalytically decomposed 90% hydrogen peroxide. Cross flow and static environments were found to yield profoundly different combustion behaviors, which were further governed by binder type, oxidizer level and, significantly, oxidizer particle size. Primary extinguishment was accomplished via manipulation of PDL behavior and oxidizer turndown which is enhanced with the hydrogen peroxide system. Laboratory scale combustor results compared very well with 11-inch and 24-inch sub-scale test results with 90% hydrogen peroxide. The implications of these results for a conceptual full-scale flight design are presented and future design optimization considerations discussed.
Author
*Gas Generators; Hybrid Propellant Rocket Engines; Hydrogen Peroxide; Oxygen; Solid Propellant Rocket Engines; Technology Utilization; Propulsion System Performance*

**20020017580** NASA Marshall Space Flight Center, Huntsville, AL USA
**X-33 XRS-2200 Linear Aerospike Engine Sea Level Plume Radiation**
DAgostino, Mark G., NASA Marshall Space Flight Center, USA; Lee, Young C., NASA Marshall Space Flight Center, USA; Wang, Ten-See, NASA Marshall Space Flight Center, USA; [2001]; 9p; In English; 26th JANNAF Exhaust Plume Technology Subcommittee Meeting, 5-9 Nov. 2001, San Antonio, TX, USA; Sponsored by NASA, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Wide band plume radiation data were collected during ten sea level tests of a single XRS-2200 engine at the NASA Stennis Space Center in 1999 and 2000. The XRS-2200 is a liquid hydrogen/liquid oxygen fueled, gas generator cycle linear aerospike engine which develops 204,420 lbf thrust at sea level. Instrumentation consisted of six hemispherical radiometers and one narrow view radiometer. Test conditions varied from 100% to 57% power level (PL) and 6.0 to 4.5 oxidizer to fuel (O/F) ratio. Measured radiation rates generally increased with engine chamber pressure and mixture ratio. One hundred percent power level radiation data were compared to predictions made with the FDNS and GASRAD codes. Predicted levels ranged from 42% over to 7% under average test values.
Author
*Aerospike Engines; Plumes; X-33 Reusable Launch Vehicle; Heat Flux*

**20020017581** NASA Marshall Space Flight Center, Huntsville, AL USA
**MSFC Combustion Devices in 2001**
Dexter, Carol, NASA Marshall Space Flight Center, USA; [2001]; 17p; In English; Pennsylvania State Univ. Propulsion Research Center 13th Annual Symposium on Propulsion, 22-23 Oct. 2001, Huntsville, AL, USA; Sponsored by Pennsylvania State Univ., USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objectives of the project detailed in this viewgraph presentation were to reduce thrust assembly weights to create lighter engines and to increase the cycle life and/or operating temperatures. Information is given on material options (metal matrix composites and polymer matrix composites), ceramic matrix composites subscale liners, lightweight linear chambers, lightweight injector development, liquid/liquid preburner tasks, and vortex chamber tasks.
CASI
*Combustion; Injectors; Composite Materials*

**20020017753** NASA Marshall Space Flight Center, Huntsville, AL USA

**An Overview of NASA's In-Space Cryogenic Propellant Management Technologies**

Tucker, Stephen, NASA Marshall Space Flight Center, USA; Hastings, Leon, NASA Marshall Space Flight Center, USA; [2001]; 22p; In English; Thermal Fluid Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Future mission planning within NASA continues to include cryogenic propellants for in space transportation, with mission durations ranging from days to years. Between 1995 and the present, NASA has pursued a diversified program of ground-based testing to prepare the various technologies associated with in-space cryogenic fluid management (CFM) for implementation. CFM technology areas being addressed include passive insulation, zero gravity pressure control, zero gravity mass gauging, capillary liquid acquisition devices, and zero boiloff storage. NASA CFM technologies are planned, coordinated, and implemented through the Cryogenic Technology Working Group which is comprised of representatives from the various NASA Centers as well as the National Institute of Standards and Technologies (NIST) and, on selected occasions, the Air Force. An overview of the NASA program and Marshall Space Flight Center (MSFC) roles, accomplishments, and near-term activities are presented herein. Basic CFM technology areas being addressed include passive insulation, zero gravity pressure control, zero gravity mass gauging, capillary liquid acquisition devices, and zero boiloff storage. Recent MSFC accomplishments include: the large scale demonstration of a high performance variable density multilayer insulation (MLI) that reduced the boiloff by about half that of standard MLI; utilization of a foam substrate under MLI to eliminate the need for a helium purge bag system; demonstrations of both spray-bar and axial-jet mixer concepts for zero gravity pressure control; and sub-scale testing that verified an optical sensor concept for measuring liquid hydrogen mass in zero gravity. In response to missions requiring cryogenic propellant storage durations on the order of years, a cooperative effort by NASA's Ames Research Center, Glenn Research Center, and MSFC has been implemented to develop and demonstrate zero boiloff concepts for in-space storage of cryogenic propellants. An MSFC contribution to this cooperative effort is a large-scale demonstration of the integrated operation of passive insulation, destratification/pressure control, and cryocooler (commercial unit) subsystems to achieve zero boiloff storage of liquid hydrogen. Testing is expected during the Summer of 2001.

Author

*Cryogenic Fluids; Evaporation; Fluid Management; Cryogenic Rocket Propellants*

**20020018156** Aerospace Corp., Technology Operations, El Segundo, CA USA

**Electromagnetic Emissions from an Engineering Model BHT-200 Thruster**

Beiting, E. J.; Pollard, J. E.; Pote, B.; Jul. 2001; 40p; In English; Original contains color images

Contract(s)/Grant(s): F04701-00-C-0009

Report No.(s): AD-A396844; TR-2001(1306)-5; SMC-TR-02-03; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Radiated electric fields were measured from a BHT-200 Hall thruster from 10 kHz to 18 GHz following MIL-STD 461E (RE102) specifications. The thruster, operated by a laboratory power supply, was located in a fiberglass vacuum tank that was enclosed in a shielded semi-anechoic room. The measurements were made for discharge potentials of 225, 250, 275, and 300 volts and anode flow rates of 0.80 0.90, 0.94, and 1.0 mg/s (150-240 W discharge power) as well as for several cathode flow rates. For all flow rates and discharge voltages, emission exceeded MIL-STD 461E limits between 10 kHz to 200 MHz. However, for the anticipated thruster operating point (250 V, 0.94 mg/s), electromagnetic emissions remained below MIL-STD 461E limits between 350 MHz and 18 GHz. Generally, electromagnetic emission decreased with increasing anode flow rate below 500 kHz and between 15-30 MHz but increased with anode flow rate between 1-5 MHz. Above 30 MHz, there was no variation of emission with anode flow rate. When the thruster operated at 250 V and 0.94 mg/s anode flow rate, emission decreased with increasing cathode flow rate below 500 kHz. There was no significant variation of emission with discharge voltage above 500 kHz. There was no appreciable difference between spectra taken with the high frequency blocking filter located inside a shielding box next to the thruster and spectra taken with the filter located outside the vacuum chamber. Spectra of the anode current oscillations recorded between 1 kHz and 50 MHz were similar to the radiated spectra and show minimal variation with cathode flow rate.

DTIC

*Emission; Electromagnetic Radiation; Hall Thrusters*

**20020018565** Thiokol Propulsion, Huntsville, AL USA

**Use of System Safety Risk Assessments for the Space Shuttle Reusable Solid Rocket Motor (RSRM)**

Greenhalgh, Phillip O., Thiokol Propulsion, USA; [2001]; 7p; In English; 19th International System Safety Conference, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper discusses the System Safety approach used to assess risk for the Space Shuttle Reusable Solid Rocket Motor (RSRM). Previous to the first RSRM flight in the fall of 1988, all systems were analyzed extensively to assure that hazards were

identified, assessed and that the baseline risk was understood and appropriately communicated. Since the original RSRM baseline was established, Thiokol and NASA have implemented a number of initiatives that have further improved the RSRM. The robust design, completion of rigorous testing and flight success of the RSRM has resulted in a wise reluctance to make changes. One of the primary assessments required to accompany the documentation of each proposed change and aid in the decision making process is a risk assessment. Documentation supporting proposed changes, including the risk assessments from System Safety, are reviewed and assessed by Thiokol and NASA technical management. After thorough consideration, approved changes are implemented adding improvements to and reducing risk of the Space Shuttle RSRM.
Author
*Safety Factors; Assessments; Design Analysis; Space Shuttle Boosters*

**20020018621** NASA Glenn Research Center, Cleveland, OH USA
**Design and Performance of 40 cm Ion Optics**
Soulas, George C., NASA Glenn Research Center, USA; December 2001; 26p; In English; 27th International Electric Propulsion Conference, 14-19 Oct. 2001, Pasadena, CA, USA; Sponsored by Air Force Research Lab., USA
Contract(s)/Grant(s): RTOP 713-81-66-00
Report No.(s): NASA/TM-2001-211275; E-13074; IEPC-01-090; NAS 1.15:211275; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A 40 cm ion thruster is being developed at the NASA Glenn Research Center to obtain input power and propellant throughput capabilities of 10 kW and 550 kg. respectively. The technical approach here is a continuation of the ”derating” technique used for the NSTAR ion thruster. The 40 cm ion thruster presently utilizes the NSTAR ion optics aperture geometry to take advantage of the large database of lifetime and performance data already available. Dome-shaped grids were chosen for the design of the 40 cm ion optics because this design is naturally suited for large-area ion optics. Ion extraction capabilities and electron backstreaming limits for the 40 cm ion optics were estimated by utilizing NSTAR 30 cm ion optics data. A preliminary service life assessment showed that the propellant throughput goal of 550 kg of xenon may be possible with molybdenum 40 cm ion optics. One 40 cm ion optics’ set has been successfully fabricated to date. Additional ion optics’ sets are presently being fabricated. Preliminary performance tests were conducted on a laboratory model 40 cm ion thruster.
Author
*Ion Engines; Ion Optics; Ion Propulsion; Performance Tests*

**20020020167** NASA Marshall Space Flight Center, Huntsville, AL USA
**Measuring Rocket Engine Temperatures with Hydrogen Raman Spectroscopy**
Wehrmeyer, Joseph A., Vanderbilt Univ., USA; Osborne, Robin J., Engineering Research and Consulting, Inc., USA; Trinh, Huu P., NASA Marshall Space Flight Center, USA; [2001]; 8p; In English; PERC Symposium on Combustion, 22-23 Oct. 2001, Huntsville, AL, USA
Contract(s)/Grant(s): NASA Order H-31539-D; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Optically accessible, high pressure, hot fire test articles are available at NASA Marshall for use in development of advanced rocket engine propellant injectors. Single laser-pulse ultraviolet (UV) Raman spectroscopy has been used in the past in these devices for analysis of high pressure H2- and CH4-fueled combustion, but relies on an independent pressure measurement in order to provide temperature information. A variation of UV Raman (High Resolution Hydrogen Raman Spectroscopy) is under development and will allow temperature measurement without the need for an independent pressure measurement, useful for flows where local pressure may not be accurately known. The technique involves the use of a spectrometer with good spectral resolution, requiring a small entrance slit for the spectrometer. The H2 Raman spectrum, when created by a narrow linewidth laser source and obtained from a good spectral resolution spectrograph, has a spectral shape related to temperature. by best-fit matching an experimental spectrum to theoretical spectra at various temperatures, a temperature measurement is obtained. The spectral model accounts for collisional narrowing, collisional broadening, Doppler broadening, and collisional line shifting of each Raman line making up the H2 Stokes vibrational Q-branch spectrum. At pressures from atmospheric up to those associated with advanced preburner components (5500 psia), collisional broadening though present does not cause significant overlap of the Raman lines, allowing high resolution H2 Raman to be used for temperature measurements in plumes and in high pressure test articles. Experimental demonstrations of the technique are performed for rich H2-air flames at atmospheric pressure and for high pressure, 300 K H2-He mixtures. Spectrometer imaging quality is identified as being critical for successful implementation of technique.
Author
*Hydrogen; Raman Spectra; Imaging Techniques; Temperature Measurement; Raman Spectroscopy*

## 23
## CHEMISTRY AND MATERIALS (GENERAL)

*Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see categories 24 through 29. For astrochemistry see category 90 Astrophysics.*

**20020016291** Oak Ridge National Lab., TN USA
**Biogenic vs. abiogenic isotope signatures of reduced carbon compounds: a lesson from hydrothermal synthesis experiments**
Horita, J.; Jun. 13, 2001; 2p; In English
Report No.(s): DE2001-787477; P01-110942; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

With growing interest in and demonstrated cases of inorganic hydrothermal synthesis of reduced or organic carbon compounds from CO and CO2, it becomes crucial to establish geochemical criteria to distinguish reduced/organic carbon compounds of abiogenic origin from those of biogenic origin with overwhelming abundances on the surface and in subsurface of the Earth. Chemical and isotopic compositions, particularly C-13/C-12 ratios, of reduced/organic carbon compounds have been widely utilized for deducing the origins and formation pathways of these compounds. An example is isotopic and C1/(C2+C3) ratios of natural gases, which have been used to distinguish bacterial, thermogenic, and possible abiogenic origins. Another example is that ancient graphitic carbon with (delta)C-13 values c-25 per thousand has been considered of biogenic origin. Although these criteria could be largely valid, growing data including those from our hydrothermal experiments suggest that a great caution must be exercised.
NTIS
*Abiogenesis; Carbon Compounds; Hydrothermal Systems; Synthesis (Chemistry); Biogeochemistry; Isotope Ratios*

**20020016788** Pacific Northwest National Lab., Richland, WA USA
**Chemical Compatibility Testing Final Report Including Test Plans and Procedures**
Nimitz,; Allred,; Gordon,; Nigrey,; McConnell,; Jul. 01, 2001; 104p; In English
Report No.(s): DE2001-783994; SAND2001-1988; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report provides an independent assessment of information on mixed waste streams, chemical compatibility information on polymers, and standard test methods for polymer properties. It includes a technology review of mixed low-level waste (LLW) streams and material compatibilities, validation for the plan to test the compatibility of simulated mixed wastes with potential seal and liner materials, and the test plan itself. Potential packaging materials were reviewed and evaluated for compatibility with expected hazardous wastes. The chemical and physical property measurements required for testing container materials were determined. Test methodologies for evaluating compatibility were collected and reviewed for applicability. A test plan to meet US Department of Energy and Environmental Protection Agency requirements was developed. The expected wastes were compared with the chemical resistances of polymers, the top-ranking polymers were selected for testing, and the most applicable test methods for candidate seal and liner materials were determined. Five recommended solutions to simulate mixed LLW streams are described. The test plan includes descriptions of test materials, test procedures, data collection protocols, safety and environmental considerations, and quality assurance procedures. The recommended order of testing to be conducted is specified.
NTIS
*Chemical Compatibility; Hazardous Wastes; Chemical Properties*

**20020017751** Thiokol Propulsion, Brigham City, UT USA
**Chemical Aging of Environmentally Friendly Cleaners**
Evans, K., Thiokol Propulsion, USA; Biegert, L., Thiokol Propulsion, USA; Olsen, B., Thiokol Propulsion, USA; Weber, B., Thiokol Propulsion, USA; [2001]; 10p; In English; 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS8-38100
Report No.(s): AIAA Paper 2001-3291; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

Use of cleaners in the manufacturing area demands bottles that will hold a sufficient amount of material and allow for easy and controlled dispensing by the operator without contamination or material leaching from the bottle. The manufacturing storage conditions are also a factor that may affect cleaner chemical integrity and its potential to leave a residue on the part. A variety of squeeze bottles stored in mild (72 F, 10 % R.H., dark) and harsh (105 F, 50 % R.H., fluorescent lighting) conditions were evaluated to determine the effect of environment and bottle exposure on the chemical composition of TCA (1,1,1 trichloroethane) replacement solvents. Low Density Polyethylene (LDPE) bottles were found to be quite permeable to all the cleaners evaluated

in this study indicating this bottle type should not be used in the manufacturing area. Fluorinated Polyethylene (FLPE) bottles showed little cleaner loss and change in cleaner chemical composition over time suggesting these bottles would be acceptable for use. Chemical analysis indicates limonene-containing cleaners show increased non-volatile residue (NVR) content with storage under harsh conditions. Some cleaners use BHT (butylated hydroxytoluene) as stabilizer and to protect against limonene oxidation. Under harsh conditions, BHT was quickly depleted resulting in higher NVR levels.
Author
*Aging (Materials); Chemical Analysis; Replacing; Polyethylenes; Oxidation; Dispensers; Depletion*

**20020019809** Army Armament Research, Development and Engineering Center, Benet Labs., Watervliet, NY USA
**Laser Pulse Heating of Gun Bore Coatings** ***Final Report***
Cote, P. J.; Kendall, G.; Todaro, M. E.; Nov. 2001; 16p; In English
Report No.(s): AD-A397184; ARCCB-TR-01023; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The authors have developed laser pulse heating as a tool for studying erosion processes at gun bore surfaces and for evaluating candidate coatings for bore protection. During firing, the bore coating and steel substrate experience thermal shock from rapid heating and cooling. Thermal pulse durations are in the millisecond range. Despite the short thermal pulse durations, severe coating and substrate degradation processes can occur; these include melting, gas/metal reactions, metallurgical transformations, interface reactions, transformational stresses, and thermal stresses. The degradation processes lead to coating cracking and spallation, which, in turn, allow erosion of the vulnerable underlying steel. Gas/metal interactions may also enhance fracture propagation in the steel. Laser pulse heating is particularly convenient for performing multiple tests on coupon specimens for early evaluations of candidate bore coatings. This allows initial screening of candidate coatings without the difficulty and expense of testing in an actual gun or in a vented combustor. Laser pulse heating has been applied to gun steel that was electroplated with high-contractile chromium, which is the conventional coating for gun bores. Laser pulse heating has also been applied to low-contractile electroplated chromium and bare steel to provide baseline information. In the present laser pulse heating experiments, samples were repeatedly pulse heated to simulate the effects of multiple gun firings. The samples were then sectioned through the pulse-heated areas and examined to assess the resulting degradation. The results validate the approach.
DTIC
*Coatings; Pulse Heating; Cavities; Gas-Metal Interactions; Steels; Guns (Ordnance); Thermal Stresses*

**20020021275** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**FOA/DSTO Uncooled IR-Sensors: Summary of Activities,** ***1994 - 2000 FOA/DSTO Okylda IR-Sensorer. Sammanfattning av Verksamheten 1994-2000***
Carlsson, G.; Ringh, U.; Dec. 2000; 32p; In Swedish; Original contains color illustrations
Report No.(s): PB2002-100838; FOA-R-00-01715-408-SE; No Copyright; Avail: National Technical Information Service (NTIS)

This report is a summary of the activities and research results obtained in the cooperation between FOA and DSTO (Defense Science and Technology Organization, Australia) in the area of uncooled IR-sensors. All publications produced within the project are referred to in the report. The research cooperation has been running from 1994 to 2000 and also involved participation from LiTh (University of linkoping) where one member of the project team received his Ph.D. Two unique and patented concepts for digital readout from an uncooled IR-array have been presented. The project was focused on the task to get one of these concepts to work in an image-generating uncooled IR-sensor. The concept meant that the analogue signal from the detector array was converted to a digital signal with 16 bits resolution in direct connection with the detector array. The sensor would thereby be completely digital, and analogue signals would not be needed for so called offset correction. The design was carried out in standard CMOS technique, making the concept useful in future uncooled image-generating IR-systems where simple processes are requested to keep the cost low. The detector development at DSTO is briefly described. We have together built and demonstrated working arrays with the resolution 16x16 and 320x240 detectors respectively. A demonstration camera has been built and samples of images are shown.
NTIS
*Australia; Infrared Detectors; Infrared Instruments; Signal Detectors; Image Processing*

## 24
## COMPOSITE MATERIALS

*Includes physical, chemical, and mechanical properties of laminates and other composite materials.*

**20020016227** National Renewable Energy Lab., Golden, CO USA
**Filler Materials for Polyphenylenesulphide Composite Coatings**
Sugama, T.; Gawlik, K.; Jul. 17, 2001; 16p; In English
Report No.(s): DE2001-783441; NREL/CP-550-30258; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Researchers at Brookhaven National Laboratory and the National Renewable Energy Laboratory have tested polymer-based coating systems to reduce the capital equipment and maintenance costs of heat exchangers in corrosive and fouling geothermal environments. These coating systems act as barriers to corrosion to protect low-cost carbon steel tubing; they are formulated to resist wear from hydroblasting and to have high thermal conductivity. Recently, new filler materials have been developed for coating systems that use polyphenylenesulphide as a matrix. These materials include boehmite crystals (orthorhombic aluminum hydroxide, which is grown in situ as a product of reaction with the geothermal fluid), which enhance wear and corrosion resistance, and carbon fibers, which improve mechanical, thermal, and corrosion-resistance properties of the composite.
NTIS
*Geothermal Technology; Protective Coatings; Corrosion Resistance; Heat Exchangers*

**20020016308** Raytheon Missile Systems Co., Tucson, AZ USA
**High Temperature Organic Composite Applications for Supersonic Missile Airframes**
Facciano, Andrew, Raytheon Missile Systems Co., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 159-178; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Missile launch and flight to target routinely results in extreme thermal shock environments due to supersonic aerodynamic heating. Designs which can meet these conditions are sometimes difficult to achieve using traditional metallic materials. This has lead Raytheon Missile Systems (RMS) to examine the applicability of high temperature organic composites for supersonic Air Intercept Missile (AIM) airframes. These composites are based primarily on Bismaleimide (BMI), Cyanate Ester (CE), and Polyimide (PI) resins. They offer considerable advantages in weight reduction, manufacturing flexibility, and reduced cost, but are usually regarded as too limited by the extreme thermal environments involved. However, internal product development and published industry advances has shown that many of these resin systems can operate in short term, thermal shock environments that easily exceed the high temperature, continuous use limits currently published by material suppliers and the aircraft industry. Consequently, these materials offer promise in the design of major AIM airframe components and possibly in innovative concepts of entire missile subsystems. This paper will review the recent advances of organic composite material technologies in the missile industry, current composite missile products of advanced high temperature airframe components at RMS, and possible future product endeavors to develop additional capabilities currently not possible with traditional metallic materials.
Author
*Airframes; High Temperature; Missile Systems; Organic Compounds; Polymer Matrix Composites; Supersonic Speed; Design Analysis*

**20020016356** Sandia National Labs., Albuquerque, NM USA
**Advanced Signal Processing for Thermal Flaw Detection**
Valley, M. T.; Hansche, B. D.; Paez, T. L.; Urbina, A.; Ashbaugh, D. M.; Sep. 01, 2001; 96p; In English
Report No.(s): DE2001-787641; SAND2001-2959; No Copyright; Avail: Department of Energy Information Bridge

Dynamic thermography is a promising technology for inspecting metallic and composite structures used in high-consequence industries. However, the reliability and inspection sensitivity of this technology has historically been limited by the need for extensive operator experience and the use of human judgment and visual acuity to detect flaws in the large volume of infrared image data collected. to overcome these limitations new automated data analysis algorithms and software is needed. The primary objectives of this research effort were to develop a data processing methodology that is tied to the underlying physics, which reduces or removes the data interpretation requirements, and which eliminates the need to look at significant numbers of data frames to determine if a flaw is present. Considering the strengths and weakness of previous research efforts, this research elected to couple both the temporal and spatial attributes of the surface temperature. of the possible algorithms investigated, the best performing was a radiance weighted root mean square Laplacian metric that included a multiplicative surface effect correction factor and a novel spatio-temporal parametric model for data smoothing. This metric demonstrated the potential for detecting flaws smaller than 0.075 inches in inspection areas on the order of one square foot. Included in this report is the development of

a thermal imaging model, a weighted least squares thermal data smoothing algorithm, simulation and experimental flaw detection results, and an overview of the ATAC (Automated Thermal Analysis Code) software that was developed to analyze thermal inspection data.
NTIS
*Algorithms; Data Smoothing; Signal Processing; Thermography*

**20020016374** National Renewable Energy Lab., Golden, CO USA
**Titanium Matrix Composite Tooling Material for Enhanced Manufacture of Aluminum Die Castings: Inventions and Innovation Metalcasting Project Fact Sheet**
Jan. 17, 2001; 2p; In English
Report No.(s): DE2001-783545; DOE/GO-102001-1030; NREL/FS-810-28254; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Project fact sheet written for the Inventions and Innovation Program about an innovative material for use in aluminum die-casting components.
NTIS
*Metal Matrix Composites; Castings*

**20020018618** Michigan State Univ., East Lansing, MI USA
**The Durability Characterization of High Temperature Polymer Matrix: Carbon Fiber Composites for Future Air Force Applications** ***Final Report, 15 Mar. 1998-14 Mar 2001***
Morgan, Roger J.; Caruthers, Jim; Drzal, Lawrence T.; Leung, Chuk; Shin, Eugene; Oct. 30, 2001; 30p; In English
Contract(s)/Grant(s): F49620-98-1-0377; AF Proj. 2306
Report No.(s): AD-A396886; AFRL-SR-BL-TR-01-0595; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Potential critical physical and chemical aging mechanisms in terms of damage initiation and propagation of bismaleimide, BMI and polymide, PI, -carbon fiber composites in future aerospace stress, time temperature moisture chemical service environments will be characterized. This characterization will be conducted on the molecular, microscopic and macroscopic structural levels in order to develop structural performance phase diagrams for mechanics model-structural design analyses and associated materials structural optimization at all dimensional levels.
DTIC
*Durability; Carbon Fiber Reinforced Plastics; Polyamide Resins; Bismaleimide*

**20020018620** Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA
**Viscoelastic Analysis of Composite Flywheels for Energy Storage** ***Final Report, Jun. 1999-Mar. 2001***
Tzeng, Jerome T.; Nov. 2001; 42p; In English; Original contains color images
Contract(s)/Grant(s): DA Proj. 622618H75
Report No.(s): AD-A396880; ARL-TR-2610; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A viscoelastic analysis has been developed to investigate stress relaxation and creep in a multilayered composite cylinder subjected to rotation. The analysis accounts for ply-by-ply variation of material properties, fiber orientations, and density gradients through the thickness of cylinders. A closed form solution based on the corresponding elastic problem is derived for a generalized plane strain state in a thick-walled, multilayered cylinder. Laplace transform is then applied to obtain the numerical solution of the viscoelastic problem. This report illustrates the derivation of the analytical model and solution procedure. A numerical simulation shows substantial creep and stress relaxation in thick-walled cylinders at an elevated temperature. Viscoelastic effects of composite can result in a drastic change of stress and strain profiles in a cylinder over a period of time, which is critical in terms of structural durability for applications such as energy storage flywheels.
DTIC
*Viscoelasticity; Composite Materials; Flywheels; Stress Relaxation; Creep Properties*

**20020018889** City Coll. of the City Univ. of New York, Materials Processing and Solid Mechanics Lab., NY USA
**Ultrasonic Assessment of Impact-Induced Damage and Microcracking in Polymer Matrix Composites**
Liaw, Benjamin, City Coll. of the City Univ. of New York, USA; Villars, Esther, City Coll. of the City Univ. of New York, USA; Delmont, Frantz, City Coll. of the City Univ. of New York, USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 16; In English; Also announced as 20020018881
Report No.(s): P8; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The main objective of this NASA FAR project is to conduct ultrasonic assessment of impact-induced damage and microcracking in polymer matrix composites at various temperatures. It is believed that the proposed study of impact damage assessment on polymer matrix composites will benefit several NASA missions and current interests, such as ballistic impact testing of composite fan containment and high strain rate deformation modeling of polymer matrix composites. Impact-induced damage mechanisms in GLARE and ARALL fiber-metal laminates subject to instrumented drop-weight impacts at various temperatures were studied. GLARE and ARALL are hybrid composites made of alternating layers of aluminum and glass (for GLARE) and aramid- (for ARALL) fiber-reinforced epoxy. Damage in pure aluminum panels impacted by foreign objects was mainly characterized by large plastic deformation surrounding a deep penetration dent. On the other hand, plastic deformation in fiber-metal laminates was often not as severe although the penetration dent was still produced. The more stiff fiber-reinforced epoxy layers provided better bending rigidity; thus, enhancing impact damage tolerance. Severe cracking, however, occurred due to the use of these more brittle fiber-reinforced epoxy layers. Fracture patterns, e.g., crack length and delamination size, were greatly affected by the lay-up configuration rather than by the number of layers, which implies that thickness effect was not significant for the panels tested in this study. Immersion ultrasound techniques were then used to assess damages generated by instrumented drop-weight impacts onto these fiber-metal laminate panels as well as 6061-T6 aluminum/cast acrylic sandwich plates adhered by epoxy. Depending on several parameters, such as impact velocity, mass, temperature, laminate configuration, sandwich construction, etc., various types of impact damage were observed, including plastic deformation, radiating cracks emanating from the impact site, ring cracks surrounding the impact site, partial and full delamination, and combinations of these damages.
Author
*Impact Damage; Microcracks; Polymer Matrix Composites; Impact Tests*

**20020018905** Prairie View Agricultural and Mechanical Coll., TX USA
**Research to Significantly Enhance Composite Survivability at 550 F in Oxidative Environments**
Byrd, Jim, Prairie View Agricultural and Mechanical Coll., USA; Guinn, LaToya, Prairie View Agricultural and Mechanical Coll., USA; Tilley, Kendra, Prairie View Agricultural and Mechanical Coll., USA; Carson, Laura, Prairie View Agricultural and Mechanical Coll., USA; Carty, Antoine, Prairie View Agricultural and Mechanical Coll., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 32; In English; Also announced as 20020018881
Report No.(s): P24; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Prairie View A&M University using the NASA FAR grant has embarked on several paths to accomplish the initial goals of: (1) synthesizing three ring aromatic diamines to be used as monomers in the synthesis of polyamide resins; and (2) study hydrothermal aging behaviors and glass transition changes of composites synthesized at NASA Glenn Research Center. In establishing the synthesis of the three ring aromatic diamine, it has become necessary to conduct preliminary synthesis to include the nitration of diphenylmethane. The concentration and temperature were altered to assess the effect of purity of isomeric product distribution in such electrophilic aromatic substitution reaction. Products were analyzed using H and C-NMR, Thin Layer Chromatography, High Pressure Liquid Chromatography and GC-Mass Spectrometry (in progress). Results indicate that by varying the concentration of the reaction, a mixture of products can be obtained. Other electrophilic aromatic substitution reactions are also in progress such as Friedel-Craft acylation reaction using diphenylmethane with 4-nitrobenzoyl chloride to afford other diamine products. Furthermore, PVAMU has nearly completed the hydrothermal studies to assess the oxidative stability of DSP443B and DSP442A panels formulated at NASA Glenn Research Center.
Author
*Composite Materials; Oxidation Resistance; Diamines; Polyamide Resins*

**20020018908** Tuskegee Inst., Center for Advanced Materials, AL USA
**Durability and Damage Development in Woven Ceramic Matrix Composites**
Haque, A., Tuskegee Inst., USA; Rahman, M., Tuskegee Inst., USA; Tyson, O. Z., Tuskegee Inst., USA; Jeelani, S., Tuskegee Inst., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 35; In English; Also announced as 20020018881
Report No.(s): P27; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Damage development in woven SiC/SiNC ceramic matrix composites (CMC's) under tensile and cyclic loading both at room and elevated temperatures have been investigated for the exhaust nozzle of high-efficient turbine engines. The ultimate strength, failure strain, proportional limit and modulus data at a temperature range of 23 to 1250 C are generated. The tensile strength of SiC/SiNC woven composites have been observed to increase with increased temperatures up to 1000 C. The stress/strain plot shows a pseudo-yield point at 25 percent of the failure strain (epsilon(sub r)) which indicates damage initiation in the form of matrix cracking. The evolution of damage beyond 0.25 epsilon(sub f), both at room and elevated temperature comprises multiple

matrix cracking, interfacial debonding, and fiber pullout. Although the nature of the stress/strain plot shows damage-tolerant behavior under static loading both at room and elevated temperature, the life expectancy of SiC/SiNC composites degrades significantly under cyclic loading at elevated temperature. This is mostly due to the interactions of fatigue damage caused by the mechanically induced plastic strain and the damage developed by the creep strain. The in situ damage evolutions are monitored by acoustic event parameters, ultrasonic C-scan and stiffness degradation. Rate equations for modulus degradation and fatigue life prediction of ceramic matrix composites both at room and elevated temperatures are developed. These rate equations are observed to show reasonable agreement with experimental results.
Author
*Ceramic Matrix Composites; Woven Composites; Durability; Damage; Tensile Stress; Cyclic Loads; Exhaust Nozzles*

**20020018909** Tuskegee Inst., Center for Advanced Materials, AL USA
**Notch Sensitivity of Woven Ceramic Matrix Composites Under Tensile Loading: An Experimental, Analytical, and Finite Element Study**
Haque, A., Tuskegee Inst., USA; Ahmed, L., Tuskegee Inst., USA; Ware, T., Tuskegee Inst., USA; Jeelani, S., Tuskegee Inst., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 36; In English; Also announced as 20020018881
Report No.(s): P28; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document
The stress concentrations associated with circular notches and subjected to uniform tensile loading in woven ceramic matrix composites (CMCs) have been investigated for high-efficient turbine engine applications. The CMC's were composed of Nicalon silicon carbide woven fabric in SiNC matrix manufactured through polymer impregnation process (PIP). Several combinations of hole diameter/plate width ratios and ply orientations were considered in this study. In the first part, the stress concentrations were calculated measuring strain distributions surrounding the hole using strain gages at different locations of the specimens during the initial portion of the stress-strain curve before any microdamage developed. The stress concentration was also calculated analytically using Lekhnitskii's solution for orthotropic plates. A finite-width correction factor for anisotropic and orthotropic composite plate was considered. The stress distributions surrounding the circular hole of a CMC's plate were further studied using finite element analysis. Both solid and shell elements were considered. The experimental results were compared with both the analytical and finite element solutions. Extensive optical and scanning electron microscopic examinations were carried out for identifying the fracture behavior and failure mechanisms of both the notched and notched specimens. The stress concentration factors (SCF) determined by analytical method overpredicted the experimental results. But the numerical solution underpredicted the experimental SCF. Stress concentration factors are shown to increase with enlarged hole size and the effects of ply orientations on stress concentration factors are observed to be negligible. In all the cases, the crack initiated at the notch edge and propagated along the width towards the edge of the specimens.
Author
*Notch Sensitivity; Woven Composites; Ceramic Matrix Composites; Tensile Stress; Stress Concentration*

**20020018910** Tuskegee Inst., Center for Advanced Materials, AL USA
**Long-Term Creep and Creep Rupture Behavior of Woven Ceramic Matrix Composites**
Haque, A., Tuskegee Inst., USA; Rahman, M., Tuskegee Inst., USA; Mach, A., Tuskegee Inst., USA; Jeelani, S., Tuskegee Inst., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 37; In English; Also announced as 20020018881
Report No.(s): P29; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document
Tensile creep behavior of SiC/SiNC ceramic matrix composites at elevated temperatures and at various stress levels have been investigated for turbine engine applications. The objective of this research is to present creep behavior of SiC/SiCN composites at stress levels above and below the monotonic proportional limit strength and predict the life at creep rupture conditions. Tensile creep-rupture tests were performed on an Instron 8502 servohydraulic testing machine at constant load conditions up to a temperature limit of 1000 C. Individual creep curves indicate three stages such as primary, secondary, and tertiary. The creep rate increased linearly at an early stage and then gradually became exponential at higher strains. The stress exponent and activation energy were also obtained at 700 and 1000 C. The specimen lifetime was observed to be 55 hrs at 121 MPa and at 700 C. The life span reduced to 35 hrs at 143 MPa and at 1000 C. Scanning electron microscopy observations revealed significant changes in the crystalline phases and creep damage development. Creep failures were accompanied by extensive fiber pullout, matrix cracking, and debonding along with fiber fracture. The creep data was applied to Time-Temperature-Stress superposition model and the Manson-Haferd parametric model for long-time life prediction.
Author
*Creep Properties; Creep Rupture Strength; Woven Composites; Ceramic Matrix Composites; Tensile Creep*

**20020019004** Wichita State Univ., National Inst. for Aviation Research, Wichita, KS USA

**Determination of Temperature/Moisture Sensitive Composite Properties** ***Final Report***

Tomblin, John S.; Salah, Lamia; Ng, Yeow C.; Sep. 2001; 73p; In English

Contract(s)/Grant(s): IA031

Report No.(s): AD-A397107; DOT/FAA/AR-01/40; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An investigation of the temperature and moisture sensitive composite properties was conducted. Results provide an evaluation of the degree of conservatism of the 50 F margin from glass transition values commonly used to determine a material system's operational limit (MOL). A series of dynamic mechanical analysis (DMA) and static mechanical tests were performed using specimens conditioned at three relative humidity levels and tested at six different temperatures for two commonly used 270 F cure prepreg systems. This report documents the results obtained from the DMA and static mechanical tests from which moisture and temperature sensitive properties can be determined. Limitations of the scope of this project are addressed as a means of providing recommendations for future research.

DTIC

*Moisture; Mechanical Properties; Composite Materials; Sensitivity; Temperature Dependence*

**20020019086** Prins Maurits Lab. TNO, Rijswijk, Netherlands

**Development of a Material Model Suitable for Simulating Ballistic Fragment Impacts on Dyneema UD-HB25** ***Final Report***
***Ontwikkeling van een Materiaalmodel Geschikt voor het Simuleren van Inslag van Ballistische Fragmenten op Dyneema UD-HB25***

vanderJagt-Deutekom, M., Prins Maurits Lab. TNO, Netherlands; July 2001; 132p; In Dutch; Original contains color illustrations

Contract(s)/Grant(s): A96/KL/453; TNO Proj. 014.11245

Report No.(s): TD-2001-0029; PMP-2001-A29; Copyright; Avail: Issuing Activity

In a collaborative project between De Staats Mijnen - High Performance Fibers (DSM-HPF), Defense Clothing and Textile Agency (DCTA) and TNO - Prins Maurits Laboratory (TNO-PML) a two-dimensional model has been developed using Autodyn to describe the ballistic impact (0 degrees NATO) of a fragment simulating projectile (FSP) on a composite material, Dyneema UD HB25. The result is an orthotropic model giving results that reasonably well agree with the experimental observations made during failure of the Dyneema material impacted by a FSP.

Author

*Protective Clothing; Terminal Ballistics; Computerized Simulation; Composite Materials*

**20020020093** California Inst. of Tech., Pasadena, CA USA

**Global Failure Modes in Composite Structures** ***Final Report***

Knauss, W. G., California Inst. of Tech., USA; Gonzalez, Luis, California Inst. of Tech., USA; July 2001; 61p; In English

Contract(s)/Grant(s): NAG1-1975; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Composite materials provide well-known advantages for space and aeronautical applications in terms of strength and rigidity to weight ratios and other mechanical properties. As a consequence, their use has experienced a constant increase in the past decades and it is anticipated that this trend will be maintained in the near future. At the same time, being these materials relatively new compared to metals, and having failure characteristics completely different from them, their damage growth and their failure mechanisms are not as well understood in a predictive sense. For example, while in metals fracture produces ”clean” cracks with their well defined analytically stress fields at the crack tip, composite fracture is a more complex phenomenon. Instead of a crack, we confront a ”damage zone” that may include fiber breakage, fiber microbuckling, fiber pullout, matrix cracking, delamination, debonding or any combination of all these different mechanisms. These phenomena are prevalent in any failure process through an aircraft structure, whether one addresses a global failure such as the ripping of a fuselage or wing section, or whether one is concerned with the failure initiation near a thickness change at stringers or other reinforcement. Thus the topic that has been under consideration has wide application in any real structure and is considered an essential contribution to the predictive failure analysis capability for aircraft containing composite components. The heterogeneity and the anisotropy of composites are not only advantageous but essential characteristics, yet these same features provide complex stress fields, especially in the presence of geometrical discontinuities such as notches, holes or cutouts or structural elements such as stiffeners, stringers, etc. to properly address the interaction between a damage/crack front and a hole with a stringer it is imperative that the stress and deformation fields of the former be (sufficiently well) characterized. The question of ”scaling” is an essential concern in any structural materials investigation. For example, experiments in the past have shown that the ”strength” of a composite depends on hole size. As a consequence the validity of traditional fracture mechanics concepts applied to composite materials failure must be questioned. The size of the fibers, the dimensions of the laminae, etc. together with the fact that, because of the layered anisotropy, the stress field is no longer two-dimensional, prevent the otherwise obviously confident use of ”similarity concepts”. Therefore, the question

needs to be raised of whether in composites ”size matters or not”, i.e., whether the results obtained in a laboratory using small coupons are truly representative of the situation involving a full scale component.
Author
*Composite Structures; Failure Modes; Mechanical Properties; Aircraft Structures; Fracture Mechanics; Failure Analysis*

**20020020363** NASA Marshall Space Flight Center, Huntsville, AL USA
**Metal Matrix Composite Materials for Aerospace Applications**
Bhat, Biliyar N., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English, 3 Dec. 2001, Nashville, TN, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Metal matrix composites (MMC) are attractive materials for aerospace applications because of their high specific strength, high specific stiffness, and lower thermal expansion coefficient. They are affordable since complex parts can be produced by low cost casting process. As a result there are many commercial and Department of Defense applications of MMCs today. This seminar will give an overview of MMCs and their state-of-the-art technology assessment. Topics to be covered are types of MMCs, fabrication methods, product forms, applications, and material selection issues for design and manufacture. Some examples of current and future aerospace applications will also be presented and discussed.
Author
*Metal Matrix Composites; Aerospace Engineering*

## 25
## INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

*Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also 34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics.*

**20020016098** Sandia National Labs., Albuquerque, NM USA
**Characterization of the Air Source and the Plume Source at FLAME**
Blanchat, H. K.; Jul. 01, 2001; 68p; In English
Report No.(s): DE2001-787358; SAND2001-2227; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes the characterization of the air source and the plume source at FLAME (the Fire Laboratory for Accreditation of Models by Experimentation). FLAME was designed to perform large indoor fire validation experiments and similar engineering sciences research activities. Validation experiments are a special class of experiment in that they are specifically designed for direct comparison with the computational models. Making meaningful comparison between the computational and experimental results requires careful characterization and control of the experimental features of parameters used as inputs into the computational model. Validation experiments must be designed to capture the essential physical phenomena, including all relevant initial and boundary conditions.
NTIS
*Mathematical Models; Plumes; Air Pollution; Control Theory*

**20020016116** Toronto Univ., Dept. of Chemistry, Ontario Canada
**Coherent Control of Chemical Reactions** ***Final Report, Jan. 1998-Oct. 2001***
Brumer, Paul W.; Oct. 29, 2001; 337p; In English
Contract(s)/Grant(s): N00014-96-1-0433
Report No.(s): AD-A396629; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

Over the past three years we have made significant contributions to the ongoing development of the coherent control of atomic and molecular processes. Specifically, we have contributed to: (1) bimolecular reaction dynamics and controlled collision phenomena; (2) control of molecular chirality and asymmetric synthesis; (3) theory, and practical considerations, in the control of the photodissociation of real systems; (4) control in large molecular systems; (5) the continued development of semiclassical mechanics specifically for coherent control applications, and (6) control of molecular nanoscale deposition on surfaces.
DTIC
*Chemical Reactions; Molecular Dynamics*

**20020016186** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Effects of structural defects on the activation of sulfur donors in GaN/x/As/1-x/ formed by N implantation**

Jasinski, J.; Yu, K. M.; Walukiewicz, W.; Liliental-Weber, Z.; Washburn, J.; Jul. 16, 2001; 10p; In English

Report No.(s): DE2001-787171; LBNL-48916; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effects of structural defects on the electrical activity of S doped GaN,As1-x layers formed by S and N coimplantation in GaAs are reported. S and N ions were implanted to the depth of about 0.4 micrometers. Electrochemical capacitance voltage measurements on samples annealed at 945 deg C for 10s show that in a thin (less than 0.1 micrometer) surface layer the concentration of active shallow donors is almost an order of magnitude larger in S and N co-implanted samples than in samples implanted with S alone.

NTIS

*Sulfur; Ion Implantation; Gallium Arsenides; Electrical Properties; Surface Defects; Nitrogen Ions; Doped Crystals*

**20020016196** California Univ., Berkeley, CA USA

**X-ray and vibrational spectroscopy of manganese complexes relevant to the oxygen-evolving complex of photosynthesis**

Visser, H.; May 16, 2001; 234p; In English

Report No.(s): DE2001-787134; LBNL-47934; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Manganese model complexes, relevant to the oxygen-evolving complex (OEC) in photosynthesis, were studied with Mn K-edge X-ray absorption near-edge spectroscopy (XANES), Mn Kb X-ray emission spectroscopy (XES), and vibrational spectroscopy. A more detailed understanding was obtained of the influence of nuclearity, overall structure, oxidation state, and ligand environment of the Mn atoms on the spectra from these methods. This refined understanding is necessary for improving the interpretation of spectra of the OEC. Mn XANES and Kb XES were used to study a di-(mu)-oxo and a mono-(mu)-oxo di-nuclear Mn compound in the (III,III), (III,IV), and (IV,IV) oxidation states. XANES spectra show energy shifts of 0.8 - 2.2 eV for 1-electron oxidation-state changes and 0.4 - 1.8 eV for ligand-environment changes. The shifts observed for Mn XES spectra were approximately 0.21 eV for oxidation state-changes and only approximately 0.04 eV for ligand-environment changes. This indicates that Mn Kb XES is more sensitive to the oxidation state and less sensitive to the ligand environment of the Mn atoms than XANES. These complimentary methods provide information about the oxidation state and the ligand environment of Mn atoms in model compounds and biological systems. A versatile spectroelectrochemical apparatus was designed to aid the interpretation of IR spectra of Mn compounds in different oxidation states. The design, based on an attenuated total reflection device, permits the study of a wide spectral range: 16,700 (600 nm) - 225

NTIS

*Vibrational Spectra; Manganese Compounds; X Rays; Photosynthesis; Absorption Spectroscopy*

**20020016219** Federal Energy Technology Center, Morgantown, WV USA

**Les software for the design of low emission combustion systems for vision 21 plants**

Cannon, S.; Adumitroaie, V.; McDaniel, K.; Smith, C.; May 01, 2001; 32p; In English

Report No.(s): DE2001-783572; FC26-00NT40975-01; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Further development of a Large Eddy Simulation (LES) code for the design of advanced gaseous combustion systems is described in this second quarterly report. CFD Research Corporation (CFDRC) is developing the LES module within the parallel, unstructured solver included in the commercial CFD-ACE+ software. CFDRC has implemented and tested Smagorinsky and localized dynamic subgrid turbulence models on a 2.1 million cell DOE-NETL combustor case and a 400,000 cell nonreacting backstep case. Both cases showed good agreement between predicted and experimental results. The large DOE-NETL case results provided better agreement with the measured oscillation frequency than previous attempts because massive parallel computing (on a cluster of 24 pcs) allowed the entire computational domain, including the swirler vanes and fuel spokes, to be modeled. Subgrid chemistry models, including the conditional moment closure (CMC) and linear eddy model (LEM), are being tested and implemented. Reduced chemical mechanisms have been developed for emissions, ignition delay, extinction, and flame propagation using a computer automated reduction method (CARM). A 19-species natural gas mechanism, based on GRI2.11 and Miller-NO(sub x), was shown to predict rich NO(sub x) emissions better than any previously published mechanisms. The ability to handle this mechanism in CFD-ACE+ was demonstrated by implementing operator splitting and a stiff ODE solver (DVODE). Efficient tabulation methods, including in situ adaptation and artificial neural nets, are being studied and will be implemented in the LES code. The LES combustion code development and testing is on schedule. Next quarter, initial results (including the DOE-NETL unstable combustor) with the CMC and LEM subgrid chemistry models will be completed and summarized.

NTIS

*Chemistry; Combustion; Computational Fluid Dynamics; Ceramic Matrix Composites; Computerized Simulation; Combustion Chambers*

**20020016241** National Energy Technology Lab., Pittsburgh, PA USA

**Functionally graded alumina/mullite coatings for protection of silicon carbide ceramic components from corrosion**

Sotirchos, S. V.; Feb. 01, 2001; 280p; In English

Report No.(s): DE2001-786900; FG22-96PC96208-11; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The main objective of this research project was the formulation of processes that can be used to prepare compositionally graded alumina/mullite coatings for protection from corrosion of silicon carbide components (monolithic or composite) used or proposed to be used in coal utilization systems (e.g., combustion chamber liners, heat exchanger tubes, particulate removal filters, and turbine components) and other energy-related applications. Since alumina has excellent resistance to corrosion but coefficient than silicon carbide, the key idea of this project has been to develop graded coatings with composition varying smoothly along their thickness between an inner (base) layer of mullite in contact with the silicon carbide component and an outer layer of pure alumina, which would function as the actual protective coating of the component. (Mullite presents very good adhesion towards silicon carbide and has thermal expansion coefficient very close to that of the latter.).

NTIS

*Ceramics; Combustion Chambers; Technology Assessment; Aluminum Oxides; Corrosion Resistance*

**20020016315** NASA Glenn Research Center, Cleveland, OH USA

**Non-Intrusive, Laser-Based Imaging of Jet-A Fuel Injection and Combustion Species in High Pressure, Subsonic Flows**

Locke, R. J., QSS Group, Inc., USA; Hicks, Y. R., NASA Glenn Research Center, USA; Anderson, R. C., NASA Glenn Research Center, USA; deGroot, W. A., QSS Group, Inc., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 263-273; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The emphasis of combustion research efforts at NASA Glenn Research Center (GRC) is on collaborating with industry to design and test gas-turbine combustors and subcomponents for both sub- and supersonic applications. These next-generation aircraft combustors are required to meet strict international environmental restrictions limiting emissions. to meet these goals, innovative combustor concepts require operation at temperatures and pressures far exceeding those of current designs. New and innovative diagnostic tools are necessary to characterize these flow streams since existing methods are inadequate. The combustion diagnostics team at GRC has implemented a suite of highly sensitive, nonintrusive optical imaging methods to diagnose the flowfields of these new engine concepts. by using optically accessible combustors and flametubes, imaging of fuel and intermediate combustion species via planar laser-induced fluorescence (PLIF) at realistic pressures are now possible. Direct imaging of the fuel injection process through both planar Mie scattering and PLIF methods is also performed. Additionally, a novel combination of planar fuel fluorescence imaging and computational analysis allows a 3-D examination of the flowfield, resulting in spatially and temporally resolved fuel/air volume distribution maps. These maps provide detailed insight into the fuel injection process at actual conditions, thereby greatly enhancing the evaluation of fuel injector performance and other combustion phenomena. Stable species such as CO2, O2, N2, H2O, and hydrocarbons are also investigated by a newly demonstrated 1-D, spontaneous Raman spectroscopic method. This visible wavelength Raman technique allows the acquisition of quantitative, stable species concentration measurements from the flow.

Author

*Combustion Physics; High Pressure; Imaging Techniques; Jet Engine Fuels; Nonintrusive Measurement; Subsonic Flow; Laser Induced Fluorescence*

**20020016414** Federal Energy Technology Center, Morgantown, WV USA

**Evaluation of Gas Reburning and Low-NO(x) Burners on a Wall-Fired Boiler: A DOE Assessment**

Feb. 28, 2001; 40p; In English

Report No.(s): DE2001-783803; DOE/NETL-2001/1143; No Copyright; Avail: Department of Energy Information Bridge

The results from the GR-LNB technology demonstrated by EER at Cherokee Station approached, but did not meet, the CCT project's performance objectives. Acceptable unit operability was achieved with both the GR and the LNB components. The gas reburning component of the process appears to be broadly applicable for retrofit NOx control to most utility boilers and, in particular, to wet-bottom cyclone boilers, which are high NOx emitters and are difficult to control (LNB technology is not applicable to cyclone boilers). GR-LNB can reduce NOx to mandated emissions levels under Title IV of the CAAA without significant, adverse boiler impacts. The GR-LNB process may be applicable to boilers significantly larger than the demonstration unit, provided there is adequate dispersion and mixing of injected natural gas. Major results of the demonstration project are summarized as follows: NOx-emissions reductions averaging 64% were achieved with 12.5% gas heat input in long-term tests on a 158-MWe (net) wall-fired unit. The target reduction level of 70% was achieved only on a short-term basis with higher gas consumption. The thermal performance of coal-fired boilers is not significantly affected by GR-LNB. Convective section steam

temperatures can be controlled within acceptable limits. Thermal efficiency is decreased by a small amount (about 0.8%), because of increased dry gas loss and higher moisture in the flue gas as a result of the GR process. Furnace slagging and convective section fouling can be adequately controlled. Because of the higher hydrogen/carbon (H/C) ratio of natural gas compared with coal, use of the GR process results in a modest reduction in CO2 emissions. SO2 and particulate emissions are reduced in direct proportion to the fraction of heat supplied by natural gas.
NTIS
*Boilers; Burners; Nitrogen Oxides*

**20020016443** Argonne National Lab., IL USA
**Introduction to pyrochemistry with emphasis on nuclear applications**
Johnson, I.; Jul. 03, 2001; 51p; In English
Report No.(s): DE2001-783631; ANL-01/16; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This report illustrates the application of thermodynamic principles to further understanding of pyrochemical processes useful for the recovery and purification of nuclear materials. It draws extensively upon the theoretical and experimental work conducted over nearly four decades in the Chemical Technology Division (formerly called the Chemical Engineering Division) of Argonne National Laboratory. After a brief discussion of fundamental thermodynamic principles and equations, they are applied to the relative distribution of actinides and other elements in molten salts and liquid metal solutions and to solubilities in liquid metal solutions.
NTIS
*Thermodynamics; Materials Recovery*

**20020016673** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**High-resolution large-acceptance analyzer for X-ray fluorescence and Raman spectroscopy**
Bergmann, U.; Cramer, S. P.; Aug. 02, 2001; 12p; In English
Report No.(s): DE2001-785274; LBNL-47595; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A newly designed multi-crystal X-ray spectrometer and its applications in the fields of X-ray fluorescence and X-ray Raman spectroscopy are described. The instrument is based on 8 spherically curved Si crystals, each with a 3.5 inch diameter form bent to a radius of 86 cm. The crystals are individually aligned in the Rowland geometry capturing a total solid angle of 0.07 sr. The array is arranged in a way that energy scans can be performed by moving the whole instrument, rather than scanning each crystal by itself. At angles close to back scattering the energy resolution is between 0.3 and 1 eV depending on the beam dimensions at the sample.
NTIS
*Raman Spectroscopy; High Resolution; X Ray Spectroscopy; X Ray Fluorescence*

**20020016675** Brookhaven National Lab., Upton, NY USA
**Scanning volta potentials measurements of metals in irradiated air**
Isaacs,; Adzic,; Jeffcoate,; Oct. 22, 2000; 8p; In English
Report No.(s): DE2001-785040; BNL-67557; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A method for direct dc measurement of the Volta potential is presented. High intensity synchrotron x-ray beams were used to locally irradiate the atmosphere adjacent to the metal surface and produce a conducting path between a sample and a reference probe. The direct measurements of potential in the ionized air could be made at probe heights of around 1 mm compared to less than 0.1 mm for the Kelvin probe. The measurements were similar to traditional Kelvin probe measurements, but had a poorer spatial resolution. In contrast to the Kelvin probe methods, the approach described allows observation of the current as a function of impressed voltage. Methods to improve the special resolution of the technique and applications to corrosion under coating will be presented.
NTIS
*Metals; Irradiation; Electric Potential; Metal Surfaces; Ionized Gases; Corrosion*

**20020016689** Sandia National Labs., Albuquerque, NM USA
**Diode Laser Diagnostics for Gas Species and Soot in Large Fires *Final Report***
Shaddix, C. R.; Allendorf, S. W.; Hubbard, G. L.; Ottesen, D. K.; Gritzo, L. A.; Jun. 01, 2001; 47p; In English
Report No.(s): DE2001-784193; SAND2001-8383; No Copyright; Avail: Department of Energy Information Bridge
The thermal hazard posed by a fire to a weapon or other engineered system is a consequence of combined radiation and convection from high-temperature soot and gases. The development of advanced, predictive models of this hazard requires

detailed knowledge of the transient chemical structure and soot distributions within real-scale fires. At present, there are no measurements, and hence limited understanding, of transient gaseous species generation and transport in large, fully turbulent fires. As part of a Laboratory Directed Research and Development (LDRD) project to develop such an experimental capability, near-infrared tunable diode laser absorption spectroscopy (TDLAS) has been identified as the most promising diagnostic technique for making these measurements. In order to develop this capability, significant efforts were applied to choosing optimal species and transitions for detection, to developing an effective multiplexing strategy for several lasers undergoing wavelength modulation spectroscopy with fast laser ramp scans, to developing a methodology for multipassing the TDL beams across a small probe volume, and finally, to designing a water-cooled, fiber-coupled probe for performing these measurements locally within large pool fires. All of these challenges were surmounted during the course of this project, and in the end a preliminary, unique dataset of combined water vapor, acetylene, and soot concentrations was obtained from a 1-m diameter JP-8 pool fire.
NTIS
*Diodes; Gas Composition; Soot; Fires; Tunable Lasers*

**20020016702** Department of Energy, Aiken, SC USA
**Iron-Catalyzed Oxidation of Hydrazine by Nitric Acid**
Karraker, D. G.; Jul. 17, 2001; 23p; In English
Report No.(s): DE2001-783929; DPST-84-759; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
To assess the importance of iron to hydrazine stability, the study of hydrazine oxidation by nitric acid has been extended to investigate the iron-catalyzed oxidation. This report describes those results.
NTIS
*Hydrazines; Nitric Acid; Oxidation*

**20020016720** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Optimization of a premixed low-swirl burner for industrial applications**
Fable, S. E.; Cheng, R. K.; Sep. 01, 2000; 5p; In English
Report No.(s): DE2001-785291; LBNL-47802; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This study was motivated by recent tests results showing that a 5cm i.d. low-swirl burner (LSB) stabilizes ultra-lean premixed turbulent flames up to 600kW. A parametric study has been performed to determine the optimum ultra-lean LSB configuration, i.e. one that will achieve low NOx and flame stability, for thermal input between 15kW to 150kW. Using Laser Doppler Velocimetry (LDV), non-reacting centerline velocity and rms fluctuation profiles were measured, and were found to show self-similar behavior. This self-similarity may explain why the flame remains stationary relative to the burner exit despite a change in bulk flow velocity from 5 to 90m/s. The recess distance of the swirler affects the shape of the mean and rms velocity profiles. Lean blow-off limits were also determined for various recess distances, and an optimum exit length was found that provides stable operation for ultra-lean flames.
NTIS
*Burners; Premixed Flames; Flow Velocity; Nitrogen Oxides; Laser Doppler Velocimeters; Flame Stability*

**20020017033** NASA Ames Research Center, Moffett Field, CA USA
**The G2(B3LYP/MP2/CC) Approach: A Modification of the G2(MP2) Approach and a Comparison with B3LYP Results**
Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; Partridge, Harry, NASA Ames Research Center, USA; [1995]; 1p; In English
Contract(s)/Grant(s): RTOP 232-01-04; Copyright; Avail: Issuing Activity; Abstract Only
The quadratic configuration interaction calculation in the G2(MP2) approach is replaced by a coupled-cluster singles and doubles calculation including a perturbational estimate of the triples excitations. In addition, the SCF and MP2 geometry optimizations and SCF frequency calculation in the G2(MP2) approach are replaced by a B3LYP geometry optimization and frequency calculation in the proposed G2(B3LYP/MP2/CC) approach. This simplification does not affect the average absolute deviation from experiment, but decreases the maximum error compared with the G2(MP2) approach. The G2(B3LYP/MP2/CC) results are compared with those obtained using the B3LYP approach, and the G2(B3LYP/MP2/CC) model is found to be more reliable, even if the B3LYP calculations are performed using a large basis set.
Author
*Configuration Interaction; Self Consistent Fields; Optimization*

**20020017036** NASA Ames Research Center, Moffett Field, CA USA

**MP2 Studies of Relativistic Effects on the Linear Stationary Points of the H+Cl2 Yields HCl+Cl and Cl+HCl Yields ClH+Cl Reactions**

Visscher, L., NASA Ames Research Center, USA; Dyall, Kenneth G., Thermoscience Inst., USA; [1995]; 1p; In English

Contract(s)/Grant(s): RTOP 232-01-04; No Copyright; Avail: Issuing Activity; Abstract Only

The influence of relativistic effects on the linear stationary points of the potential energy surfaces of the ClHCl and HCl2 systems is studied. Scalar relativistic effects have little influence on the geometries and the energies of these points. Spin-orbit effects have no influence on the barrier of the forward reaction of H with Cl2, but increase the reaction energy. The total relativistic effect is an increase of the reaction energy by 2.3 kJ /mol. The barrier for the iso-energetic exchange reaction of HCl with Cl is decreased by 0.5 kJ /mol due to the scalar relativistic effects. This small decrease is cancelled by the larger increase of 2.5 kJ /mol due to spin-orbit effects, giving a total relativistic effect of 2.0 kJ /mol.

Author

*Potential Energy; Hydrochloric Acid; Relativistic Effects*

**20020017463** Office of Naval Research European Office, FPO New York, NY USA

**The International Conference on Intergranular and Interphase Boundaries (10th) Held in Haifa, Israel on July 23-26, 2001** ***Final Report, 23-28 Jul. 2001***

Jul. 26, 2001; 107p; In English; Report contains abstracts of conference proceedings only

Report No.(s): AD-A396806; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This volume contains abstracts of paper presented at the 10th. International Conference on Intergranular and Interphase Boundaries (IIB2001) held in Haifa, Israel on July 23-26, 2001. Session topics include: Interfacial structure & defects; electronic structure at interfaces; interfaces in nano-structures; solid-liquid interfaces & wetting; segregation; grain boundary & interface ensembles; interface energy & morphology; interface diffusion & external fields; interface motion & dynamics.

DTIC

*Grain Boundaries; Electronic Structure; Diffusion; Defects*

**20020017522** NASA Ames Research Center, Moffett Field, CA USA

**The Sensitivity of B3LYP Atomization Energies to the Basis Set and a Comparison of the Basis Set Requirements for CCSD(T) and B3LYP**

Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; Partridge, Harry, NASA Ames Research Center, USA; [1995]; 1p; In English

Contract(s)/Grant(s): RTOP 232-01-04; No Copyright; Avail: Issuing Activity; Abstract Only

The atomization energies of the 55 G2 molecules are computed using the B3LYP approach with a variety of basis sets. The 6-311 + G(3df) basis set is found to yield superior results to those obtained using the augmented - correlation - consistent valence-polarized triple-zeta set. The atomization energy of SO2 is found to be the most sensitive to basis set and is studied in detail. Including tight d functions is found to be important for obtaining good atomization energies. The results for SO2 are compared with those obtained using the coupled-cluster singles and doubles approach including a perturbational estimate of the triple excitations.

Author

*Atomizing; Molecules; Sensitivity*

**20020017935** Stanford Linear Accelerator Center, CA USA

**Corrosion of Glass Windows in DIRC PMTs**

Javrosla, J.; Jul. 27, 2001; 33p; In English

Report No.(s): DE2001-787189; SLAC-PUB-8877; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The DIRC photon detector contains approx. 11,000 photomultipliers (PMTs), which are submerged in ultra-pure water. This note reports on glass corrosion R&D conducted with PMTs in pure water. We conclude that only limited number (approx. 50) of the PMTs in water are effected by rapid corrosion, while a majority of the 11,000 PMTs should last, according to our measurements, for another ten years. The observation of PMT glass corrosion is based on visual observations, X-ray surface analysis, ESCA surface analysis, weight analysis, transmission measurement, as well as detailed water trace element analysis. We also correlate these observations with DIRC measurements of water pH factor, resistivity, temperature, transmission, and BaBar analysis of Bhabha and di-muon events. We also compare DIRC water purity with that of the Super Kamiokande and K2K

experiments, which also use ultra-pure water. We provided empirical proof that corrosion, in our particular Borosilicate type of PMT glass window, occurs at high rate when the glass has no Zn content.
NTIS
*Corrosion; Photomultiplier Tubes; Glass; Purity*

**20020018004** National Inst. of Standards and Technology, Gaithersburg, MD USA
**Laser-Assisted Vaporization Mass Spectrometry: Application to Thermochemistry at Very High Temperatures**
Hastie, J. W.; Bonnell, D. W.; Schenck, P. K.; Sep. 2001; 142p; In English
Report No.(s): PB2001-108774; NISTIR-6793; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Classical mass spectrometrically-based approaches to the determination of high temperature thermochemical data and functions are limited in their applicable ranges of temperature and vapor pressure. An earlier laser-based mass spectrometric approach substantially overcame these limitations, but with reduced precision in temperature and pressure determination. Here, the authors present new methods that largely resolve the earlier limitations of laser-assisted vaporization mass spectrometry, thereby greatly expanding the scope of application of high temperature mass spectrometric techniques to ceramics and other refractory systems.
NTIS
*Thermochemistry; Ceramics; Mass Spectroscopy*

**20020018182** National Energy Technology Lab., Pittsburgh, PA USA
**Experiments and computational modeling of pulverized-coal ignition**
Owusu-Ofori, S.; Chen, J. C.; Dec. 29, 1999; 50p; In English
Report No.(s): DE2001-787566; FG22-96PC96221--06; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Under typical conditions of pulverized-coal combustion, which is characterized by fine particles heated at very high rates, there is currently a lack of certainty regarding the ignition mechanism of bituminous and lower rank coals as well as the ignition rate of reaction. Furthermore, there have been no previous studies aimed at examining these factors under various experimental conditions, such as particle size, oxygen concentration, and heating rate. Finally, there is a need to improve current mathematical models of ignition to realistically and accurately depict the particle-to-particle variations that exist within a coal sample. Such a model is needed to extract useful reaction parameters from ignition studies, and to interpret ignition data in a more meaningful way. The authors propose to examine fundamental aspects of coal ignition through (1) experiments to determine the ignition temperature of various coals by direct measurement, and (2) modeling of the ignition process to derive rate constants and to provide a more insightful interpretation of data from ignition experiments. The authors propose to use a novel laser-based ignition experiment to achieve their first objective. Laser-ignition experiments offer the distinct advantage of easy optical access to the particles because of the absence of a furnace or radiating walls, and thus permit direct observation and particle temperature measurement. The ignition temperature of different coals under various experimental conditions can therefore be easily determined by direct measurement using two-color pyrometry. The ignition rate-constants, when the ignition occurs heterogeneously, and the particle heating rates will both be determined from analyses based on these measurements.
NTIS
*Coal; Ignition; Computerized Simulation; Combustion*

**20020018188** Oak Ridge National Lab., TN USA
**Structure of the Electric Double Layer in Hydrothermal Systems. Molecular Simulation Approach and Interpretation of Experimental Results**
Chialvo, A. A.; Jun. 19, 2001; 4p; In English
Report No.(s): DE2001-787479; P01-111111; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

When an aqueous electrolyte solution is put in contact with a solid surface the solid-liquid interface develops a net electric polarization resulting from the formation of an electric double layer. This phenomenon has been known for more than a century, giving rise to a variety of theories including the first one by Helmholtz followed by Gouy-Chapman, and Bockris-Devanathan-Miller. The existence of the electric double layer has a strong impact on many chemical (electrochemical metal deposition, corrosion, catalysis), biochemical (ion channels), and geological (mineral dissolution/deposition and reactivity, crystallization) processes due to charge-shielding resulting from the movement of ions toward the interface to balance the charged surface. Typically, the theoretical investigation of the microscopic structure of the medium near the (charged or uncharged) interface has been done with simplified models, involving a structureless surface in contact with point (or hard-sphere) ions immersed in a dielectric continuum. Obviously, these models neglect important physicochemical aspects of the system, such as

the solvent structure around the species in solution (solvation effects), as well as the reactive interaction between the solvent and the solid surface. In order to interpret the actual electrochemical behavior of ionic species in solution, their interaction with the solid surface and their mobility we need to develop molecular-based tools. These tools must take explicitly into account the discrete nature of all species in solution and the essential features to describe the solid surface and its interactions with the contact solution (ultimately, it will include the discrete nature of the surface). The main goal of our research is the analysis of the microscopic behavior of high-temperature aqueous electrolyte solutions in contact with metal oxide surfaces, to gain an improved understanding of the configurational behavior of the electric double layer. For that purpose we develop molecular dynamics protocols to characterize formation of the electric double layer through the determination of the profiles of species; concentrations, electric field, species diffusivity, and solvent polarization normal to the oxide surface.
NTIS
*Hydrothermal Systems; Aqueous Solutions; Liquid-Solid Interfaces; Polarization (Charge Separation); Electrical Properties*

**20020018619** Fraunhofer-Inst. fuer Chemische Technologie, Berghausen Germany
**32nd International Annual Conference of ICT. Energetic Materials: Ignition, Combustion and Detonation** ***Final Report, 3-8 Jul. 2001***
Jul. 06, 2001; ISSN 0722-4807; 1639p; In English; In German, 3-6 Jul. 2001, Karlsruhe, Germany
Report No.(s): AD-A396885; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche
These are presentation and poster session papers presented at the 32nd International Annual Conference of ICT held in Karlsruhe, Germany, on July 3-6, 2001. The main topic concerning energetic materials is the formulation and synthesis of new components. Their characterization is based on experimental research of ignition, combustion and detonation phenomena. Conference objectives include experimental and theoretical activities on: initiation and ignition processes; investigation of combustion and detonation phenomena, plume signature, and improved diagnostics and measurement techniques.
DTIC
*Conferences; Combustion Physics*

**20020018891** NASA Glenn Research Center, Cleveland, OH USA
**Substituent and Solvent Effects on Excited State Charge Transfer Behavior of Highly Fluorescent Dyes Containing Thiophenylimidazole-Based Aldehydes**
Santos, Javier, NASA Glenn Research Center, USA; Bu, Xiu R., Clark-Atlanta Univ., USA; Mintz, Eric A., Clark-Atlanta Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 18; In English; Also announced as 20020018881
Report No.(s): P10; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document
The excited state charge transfer for a series of highly fluorescent dyes containing thiophenylimidazole moiety was investigated. These systems follow the Twisted Intramolecular Charge Transfer (TICT) model. Dual fluorescence was observed for each substituted dye. X-ray structures analysis reveals a twisted ground state geometry for the donor substituted aryl on the 4 and 5 position at the imidazole ring. The excited state charge transfer was modeled by a linear solvation energy relationship using Taft's pi and Dimroth's E(sub T)(30) as solvent parameters. There is linear relation between the energy of the fluorescence transition and solvent polarity. The degree of stabilization of the excited state charge transfer was found to be consistent with the intramolecular molecular charge transfer. Excited dipole moment was studied by utilizing the solvatochromic shift method.
Author
*Solvents; Excitation; Charge Transfer; Dyes; Fluorescence; Aldehydes*

**20020019076** ELEX-KM Publishers, Moscow, Russia
**High-Speed Deflagration and Detonation: Fundamentals and Control. International Colloquium on Control and Detonation Processes** ***Final Report***
Roy, Gabriel D., Editor; Frolov, Sergei M., Editor; Netzer, David W., Editor; Borisov, Anatolii A., Editor; Jun. 2001; 385p; In English, 4-7 Jul. 2000, Moscow, Russia; Original contains color images
Contract(s)/Grant(s): N00014-99-1-077
Report No.(s): AD-A396937; ISBN 5-93815-003-5; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche
Twenty two papers on fundamentals of high-speed deflagrations and detonations written by international experts are assembled in this volume. The papers have been presented at the International Colloquium on Control of Detonation Processes held in Moscow, Russia on July 4-7, 2000. Various aspects of deflagration to detonation transition as well as direct detonation initiation in gaseous and heterogeneous media are discussed with the emphasis on control of the predetonation distance and

parameters of transient high-speed combustion regimes. Applications of various explosion control techniques to pulsed detonation engines (PDE) are described.
DTIC
*Internal Combustion Engines; Deflagration; Control Systems Design; Detonation Waves*

**20020019231** NASA Ames Research Center, Moffett Field, CA USA
**The Successive H2O Binding Energies for Fe(H2O)n(+)**
Ricca, Alessandra, NASA Ames Research Center, USA; Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; [1994]; 1p; In English
Contract(s)/Grant(s): RTOP 232-01-04; No Copyright; Avail: Issuing Activity; Abstract Only
The binding energy, computed using density functional theory (DFT), are in good agreement with experiment. The bonding is electrostatic (charge-dipole) in origin for all systems. The structures are therefore determined mostly by metal-ligand and ligand-ligand repulsion. The computed structure for FeH2O(+) is C(2v) where sp hybridization is important in reducing the Fe-H2O repulsion. Fe(H2O)2(+) has D2d symmetry where sdo hybridization is the primary factor leading to the linear O-Fe-O geometry. The bonding in Fe(H2O)3(+) and Fe(H2O)4(+) are very complex because ligand-ligand and metal-ligand repulsion, both for the in-plane and out-of-plane water lone-pair orbitals, are important.
Author
*Binding Energy; Water; Iron*

**20020019805** Federal Aviation Administration, Office of Aviation Research, Washington, DC USA
**Calculating Polymer Flammability from Molar Group Contributions** ***Final Report***
Walters, Richard; Lyon, Richard E.; Sep. 2001; 32p; In English; Prepared in collaboration with Galaxy Scientific Corp, Egg Harbor, NJ
Report No.(s): AD-A397200; DOT/FAA/AR-01/31; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Specific heat release rate is the molecular-level fire response of a burning polymer. The Federal Aviation Administration (FAA) obtains the specific heat release rate of milligram samples by analyzing the oxygen consumed by complete combustion of the pyrolysis gases during a linear heating program. Dividing the specific heat release rate (W/g) by the rate of temperature rise (K/s) gives a material fire parameter with the units (J/g-K) and significance of a heat (release) capacity. The heat release capacity appears to be a true material property that is rooted in the chemical structure of the polymer and is calculable from additive molar group contributions. Hundreds of polymers of known chemical composition have been tested to date, providing over 40 different empirical molar group contributions to the heat release capacity. Measured and calculated heat release capacities for 80 polymers agree to within plus or minus 15%, suggesting a new capability for predicting flammability from polymer chemical structure.
DTIC
*Combustion Physics; Flammability; Thermochemistry; Pyrolysis; Polymers*

**20020020428** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Characterisation of Tetanus Toxin, Neat and in Culture Supernatant, by Electrospray Mass Spectrometry** ***Final Report***
***Identificatie van Toxinen: Massaspectrometrie van Tetanus Toxine***
vanBaar, B. L. M., Prins Maurits Lab. TNO, Netherlands; Wils, E. R. J., Prins Maurits Lab. TNO, Netherlands; Hulst, A. G., Prins Maurits Lab. TNO, Netherlands; Roberts, B., Chemical and Biological Defense Establishment, UK; October 2001; 28p; In English
Contract(s)/Grant(s): A93/KL/424; TNO Proj. 014.12826
Report No.(s): TD-2001-A51; PML-2001-A51; Copyright; Avail: Issuing Activity
A method was developed for the identification of tetanus toxin (TTX) by the combination of liquid chromatography electrospray mass spectrometry (LC ES MS). TTX belongs with the related botulinum toxin to the family of extremely neurotoxic clostridial toxins. The method combines sample treatment in a safety containment and analysis of detoxified material in a common laboratory facility. TTX is subjected to a sample treatment step consisting of reduction, alkylation and tryptic digestion on a molecular weight cut-off (MWCO) filter. The tryptic fragments are characterized by accurate mass measurement or by tandem MS amino acid sequencing of selected peptides. The method was applied to the characterization of neat TTX and subsequent identification of the toxin in cell lysate supernatants and culture supernatants from different Clostridium tetani bacteria strains.

by LC-MS/MS analysis of selected precursor ions from the tryptic fragments a reliable identification level of 1 micrograms/ml could be achieved in crude culture supernatants.
Author
*Toxins and Antitoxins; Liquid Chromatography; Mass Spectroscopy*

**20020020672** Department of Energy, Aiken, SC USA
**Characterization of Tank 49H Solids**
Wilmarth, W. R.; Aug. 31, 1999; 17p; In English
Report No.(s): DE2001-10529; WSRC-TR-99-00199; No Copyright; Avail: Department of Energy Information Bridge
Tank 49H contains wash water from the 1983 demonstration of the In-Tank Precipitation Process. SRTC helped study the decomposition of sodium and potassium tetraphenylborate present within the tank.
NTIS
*Storage Tanks; Decomposition; Potassium Compounds; Sodium Compounds*

**20020020996** National Defence Research Establishment, Avd. foer Vapen och Skydd, Tumba, Sweden
**Smoke Spread Trials in a Small-Scale, Multi-Plane Configuration**
Walmerdahl, P.; Werling, P.; Nireus, K.; Feb. 2000; ISSN 1104-9154; 38p; In English
Report No.(s): PB2002-100656; FOA-R-00-01447-311-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Multi-level buildings and facilities often face difficulties in the event of smoke spread subsequent to fire outbreak. The smoke spread will to a large extent depend on ventilation conditions and factors such as fire source and size. In order to develop a further understanding of the smoke spread in underground facilities, shopping malls and passenger ships for instance, several experiments were performed in scale 1:3. These tests also help to create well-defined data for future simulation of the events. The model consisted of a three plane configuration with an atria in the middle. Kerosene was the fuel used to generate the fire, which was located in one of the bottom compartments. The fire size and ventilation conditions were varied and measurements were done on temperatures, mass flow through the ceiling vent, mass burning rates, oxygen concentrations and visibility. Visual estimates of the development of smoke layers was also done. Results are mainly presented as mean values in tables, but for two tests the full experimental data are given.
NTIS
*Smoke; Simulation; Flow Distribution; Visibility; Ventilation*

## 26
## METALS AND METALLIC MATERIALS

*Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.*

**20020016256** Oak Ridge National Lab., TN USA
**High Temperature Corrosion Behavior of Iron Aluminide Alloys and Coatings**
Pint, B. A.; Oct. 22, 2001; 12p; In English
Report No.(s): DE2001-788001; P99-103214; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A multi-year effort has been focused an optimizing the large-term oxidation performance of ingot-processed (IP) and oxide-dispersion strengthened (ODS) Fe3A1 and iron aluminide-based coatings. Based on results from several composition iterations, a Hf-doped alloy (Fe-28A1-2Cr-0.05at.%Hf) has been developed with significantly better high temperature oxidation resistance than other iron aluminides. The scale adhesion is not significantly better; however, the oc-A1203 scale grows at a slower rate, approximately a factor of 10 less than undoped iron aluminide. The benefit of Hf is greatest at 1100 - 1200 C. Long-term oxidation resistance of commercially fabricated CDSFe3A1 has been determined and compared to commercially available CSD FeCrA1. Scale spallation rates for CDS Fe3A1 are higher than for CDS FeCrA1. to complement studies of iron-aluminide weld-overlay coatings, carbon steel was coated with Fe-Al-Cr by thermal spraying. These specimens were then exposed in the air at 900 and 1000 C and in air - 1%SO2at 800 C. Most likely due to an inadequate aluminum concentration in the coatings, continuous protective A12O3 could not be maintained and, consequently, the corrosion performance was significantly worse than what is normally observed for Fe3A1.
NTIS
*Aluminum Alloys; High Temperature Tests; Corrosion; Oxidation Resistance; Iron Aluminides; Fabrication*

**20020016257** Oak Ridge National Lab., TN USA

**Microstructure Development During Sintering of TiC-Ni3A1 Cermets**

Tiegs, T. N.; Oct. 22, 2001; 15p; In English

Report No.(s): DE2001-787972; P99-102993; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

TiC-Ni3A1 cermets are under development for application in diesel engines because of desirable physical properties and wear resistance. Powder compacts with binder contents from 30-50 vol. % were fabricated by pressureless sintering under vacuum followed by low gas pressure isostatic pressing. Increasing the Ni3A1 content improved densification when using prealloyed powders as expected. However, when the Ni3A1 was formed by in-situ reaction synthesis of Ni and NiA1, densification decreased with higher binder contents. The final microstructure consisted of a 'core-rim' structure with TiC cores surrounded by (Ti,W)C rims. In some cases, Ni and A1 were also observed in the peripheral region of the rim structure. Grain sizes of the TiC increased with binder content and temperature. Preferred orientation of the Ni3A1 binder phase was observed due to very large grain sizes on the order of millimeters.

NTIS

*Sintering; Microstructure; Product Development; Cermets; Wear Resistance*

**20020016292** Oak Ridge National Lab., TN USA

**Solution Deposition Approaches to Coated Conductor Fabrication on Biaxially Textured Ni-W Alloy Substrates**

Sathyamurthy, S.; Jun. 20, 2001; 3p; In English

Report No.(s): DE2001-787473A; P01-110936; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Sol-gel processing of La2Zr2O7 (LZO) was used to process buffer layers on biaxially textured Ni-3 at.%W substrates. A reel-to-reel continuous dip-coating unit was used to deposit the solution buffers. Epitaxial LZO films have been obtained through continuous processing on Ni-3 at.%W substrates with strong texture and uniform microstructure. The carbon content in these films were analyzed using proton resonance Rutherford Backscattering (RBS). The process parameters have been modified so as to study the effect of the carbon content in these films towards further growth of YBCO films with better properties. The LZO buffers were used as seed layers for RABiTS with the architecture of CeO2/YSZ/LZO/Ni-3 at.%W, and YBCO films with critical current density (J(sub c)) of 1.9 MA per square centimeter at 77K in self-field, and a J(sub c) of 0.34 MA per square centimeter at 0.5 T, have been obtained.

NTIS

*Coatings; Conductors; Fabrication; Sol-Gel Processes; Substrates; Deposition; Nickel Alloys; Tungsten Alloys*

**20020016311** Brigham Young Univ., Provo, UT USA

**A Summary of Aluminum Combustion**

Beckstead, M. W., Brigham Young Univ., USA; Newbold, B. R., Brigham Young Univ., USA; Waroquet, C., Brigham Young Univ., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 201-220; In English; Also announced as 20020016300

Contract(s)/Grant(s): N00014-95-I-1338; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The combustion characteristics of aluminum combustion are summarized in an overview of the subject, focusing on the burning time of individual particles. The fundamental concepts that control aluminum combustion are discussed starting with a discussion of the "D(sup n)" law. Combustion data from over ten different sources with almost 400 datum points have been cataloged and correlated. Available models have also been used to evaluate combustion trends with key environmental parameters. The exponent is shown to be less than two, with nominal values of approx. 1.5 to 1.8 being typical. The effect of oxidizer is pronounced with oxygen being twice as effective as water and about five times more effective than carbon dioxide. The observed effect of pressure and initial temperature is minimal.

Author

*Aluminum; Burning Time; Metal Combustion; Oxidizers*

**20020016359** Brookhaven National Lab., Upton, NY USA

**Electronic Structure of Ag/Cu(100) Surface Alloys Studies by Auger-Photoelectron Coincidence Spectroscopy**

Arena, A.; Bartynski, A.; Hulbert, L.; Oct. 08, 2001; 12p; In English

Report No.(s): DE2001-787633; BNL-68659; No Copyright; Avail: Department of Energy Information Bridge

We have measured the Ag and Pd M(sub 5)VV Auger spectrum in coincidence with Ag and Pd 4d(sub 5/2) photoelectrons for the Ag/Cu(100) and Pd/Cu(100) systems, respectively, as a function of admetal coverage. These systems form surface alloys (i.e., random substitutional alloys in the first atomic layer) for impurity concentrations in the 0.1 monolayer range. For these systems, the centroid of the impurity 4d levels is expected to shift away from the Fermi level by approximately 1 eV, an effect that should be easily seen in coincidence core-valence-valence Auger spectra. We find that the impurity Auger spectra of both

systems shift in a manner that is consistent with d-band moving away from E(sub F). However, the shift for Pd is considerably smaller than expected, and a shift almost absent for Ag. The disagreement between theory and experiment is most likely caused by the neglect of lattice relaxations in the calculations.
NTIS
*Electronic Structure; Impurities; Silver Alloys; Lead (Metal)*

**20020016389** Argonne National Lab., IL USA
**Modeling and simulation of fragmentation of suddenly heated liquid metal jets**
Hassanein, A.; Konkashbaev, I.; Jun. 26, 2001; 27p; In English
Report No.(s): DE2001-783632; ANL-ET/01-13; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Thermoelastic response of liquid metal targets exposed to high-volumetric-energy deposition in times shorter than the target hydrodynamic response time (i.e., sound travel time) is of interest to several research areas, including first walls of fusion reactors (especially inertially confined fusion reactors), targets for high-power accelerators such as the Spallation Neutron Source, muon collider targets, etc. Under conditions that exist in these reactors, accelerators, etc., the deposited energy is considered instant in time from the hydrodynamic point of view. Because thermal heat conduction requires a longer than instant response time for energy redistribution, only hydrodynamic phenomena should be taken into account when modeling and simulating the fragmentation of suddenly heated liquid metal jets. Sudden energy deposition causes an instant rise in temperature that leads to a corresponding rise in the thermal pressure that causes excitation of sound waves, i.e., shock waves and rarefaction waves. During this excitation of sound waves, pressure oscillates with magnitude +/- (Delta)P that corresponds to an initial thermal pressure of tens of katm. Liquids are frequently observed to withstand significant negative pressures (hydrostatic tensile stresses). Yet, a liquid subjected to a negative pressure is metastable. The formation and behavior of cavities (empty voids) under negative pressures was previously studied. Theoretically, the obtained fracture (failure) pressure of mercury is in good agreement with experimental results. Cavitation, or spontaneous formation of cavities, in stressed liquid metal targets is of interest to engineers and physicists who operate high-power targets in fusion reactors, nuclear accelerators, and particle colliders. The problems of liquid target oscillation in the presence of large magnitudes of negative pressure, and the mechanism of fragmentation and its consequences are considered in this analysis. It is shown that a cavity coming into existence will initiate a shock wave that is actually a relaxation shock wave initiated when the stretched medium reverts to normal density from the low-density state. The nature of this relaxation wave is similar to that of the detonation wave. It is also shown that a cavity born at the high-negative-pressure stage expands permanently and does not disappear. This permanent expansion and failure to disappear is a major difference between the cavity dynamics in stretched media and the dynamics observed in the usual cavitation processes that occur when vapor bubbles collapse during a phase of increased pressure, and is the result of ”unloading” or ”discharging” of the medium by the relaxation shock wave initiated by the appearance of the cavity. Detailed calculations of cavity dynamics are presented for both spherical and cylindrical liquid metal target systems.
NTIS
*Fragmentation; Liquid Metals; Thermoelasticity; Energy Transfer; Spallation; Neutron Sources*

**20020016668** Lawrence Livermore National Lab., Livermore, CA USA
**Elasticity of Tantalum to 105 Gpa using a stress and angle-resolved x-ray diffraction**
Cynn, H.; Yoo, C. S.; Aug. 11, 1999; 7p; In English
Report No.(s): DE20-0113792D; UCRL-JC-135362; REPT-98-ER-059; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Determining the mechanical properties such as elastic constants of metals at Mbar pressures has been a difficult task. Following the development of anisotropic elastic theory by Singh et al. (l), Mao et a1.(2) have recently developed a novel experimental technique to determine the elastic constants of Fe by using the stress and energy-dispersive x-ray diffraction (SEX). In this paper, we present an improved complementary technique, stress and angle-resolved x-ray diffraction (SAX), which we have applied to determine the elastic constants of tantalum to 105 GPa. The extrapolation of the tantalum elastic data shows an excellent agreement with the low-pressure ultrasonic data (3). We also discuss the improvement of this SAX method over the previous SEX.
NTIS
*Tantalum; Anisotropy; X Ray Sources; X Ray Diffraction; Elastic Properties*

**20020016683** Department of Energy, Aiken, SC USA

**High Strength Stainless Steel Properties that Affect Resistance Welding**

Kanne, W. R.; Aug. 01, 2001; 38p; In English

Report No.(s): DE2001-784245; DPSP-83-1030; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report discusses results of a study on selected high strength stainless steel alloy properties that affect resistance welding. The austenitic alloys A-286, JBK-75 (Modified A-286), 21-6-9, 22-13-5, 316 and 304L were investigated and compared. The former two are age hardenable, and the latter four obtain their strength through work hardening. Properties investigated include corrosion and its relationship to chemical cleaning, the effects of heat treatment on strength and surface condition, and the effect of mechanical properties on strength and weldability.

NTIS

*Weldability; Stainless Steels; High Strength Steels; Welding*

**20020016688** Sandia National Labs., Albuquerque, NM USA

**Tritium Performance of Alloy 22-13-5**

Robinson, S. L.; Jun. 01, 2001; 30p; In English

Report No.(s): DE2001-784195; SAND2001-8184; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Previously published studies of the performance of high strength austenitic steels and superalloys in tritium have demonstrated significant shortcomings in toughness and sensitivity to decay helium in the metal matrix. The alloy 22Cr-13Ni-5Mn exhibits high cracking thresholds in hydrogen, and promising performance in tritium-charged and aged smooth tensile specimens. It is readily forged to strengths beyond 690 MPa, and is commercially available. The tensile performance of 22-13-5 is compared to that of 21-6-9 and JBK-75. Aspects of a development program are outlined.

NTIS

*High Strength Steels; Tritium; Heat Resistant Alloys*

**20020018011** Center for Mathematics and Computer Science, Amsterdam Netherlands

**Vector Valued Stafan Problem from Aluminium Industry. Modelled, Analysis and Simulation**

Vermolen, F. J.; Vuik, K.; Jul. 1998; 22p; In English

Report No.(s): PB2001-108503; MAS-R9814; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Dissolution of stoichiometric multi-component particles in ternary alloys is an important process occurring during the heat treatment of as-cast aluminum alloys prior to hot-extrusion. A mathematical model is proposed to describe such a process. In this model an equation is given to determine the position of the particle interface in time, using two diffusion equations which are coupled by nonlinear boundary conditions at the interface. Moreover the well-posedness of the moving boundary problem is investigated using the maximum principle for the parabolic partial differential equation. Furthermore, for an unbounded domain and planar coordinates an analytical asymptotic approximation based on self-similarity is derived. This asymptotic approximation gives insight into the well-posedness of the problem.

NTIS

*Aluminum Alloys; Asymptotic Methods; Boundary Value Problems; Vectors (Mathematics)*

**20020018135** Brookhaven National Lab., Upton, NY USA

**Kinetics of Pitting Corrosion in Gels**

Isaacs,; Adzic,; Oct. 22, 2000; 6p; In English

Report No.(s): DE2001-785044; BNL-67574; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An investigation has been carried out on stainless steel to determine the important parameters that related the changes in pH around pits to the current coming from the pits. Potentiodynamic measurements at 1 mV/s were made on Type 302 stainless steel in agar containing 1M NaCl and a wide range pH indicator. Many pits suddenly appeared at the pitting potential, as indicated by the red, low pH region around the pits. Simulations of the changes in pH were based on diffusion from a point current source. The results also were considered in terms of the effects of a minimum detectable thickness of pH change within the gel.

NTIS

*Corrosion; Gels; pH; Pitting; Computerized Simulation*

**20020018144** Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA
**Hot Explosive Consolidation of W-Ti Alloys: Microstructural Effects** ***Final Report, Jan. 1992-Dec. 1997***
Kecskes, Laszlo J.; Nov. 2001; 54p; In English; Original contains color images
Contract(s)/Grant(s): DA Proj. IL6-22105-AH-84
Report No.(s): AD-A396876; ARL-TR-2615; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Full-density W-Ti alloys have been fabricated by a recently developed, hot-explosive-compaction (HEC) technique. The alloy billets, which are formed, consist of W grains embedded in a generally discontinuous, preferentially oriented Ti-rich matrix. The effects of the use of different types of precursor powders, the influence of the W-Ti ratio on the dispersability of the W grains in the alloy, and the post-consolidation anneal control of the Ti-rich matrix were of primary interest. The alloy billets were analyzed by X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS). The major features of the technique and the microstructural properties of the W-Ti alloys are presented.

DTIC

*Microstructure; Titanium Alloys; Tungsten Alloys; Compacting; Consolidation; High Temperature*

**20020018158** Battelle Memorial Inst., Columbus, OH USA
**Creep-Rupture Properties of 6061-T6 Aluminum Alloy at 450 and 500 F**
Saller, H. A.; VanEcho, J. A.; Stacy, J. T.; Dec. 20, 1954; 12p; In English
Contract(s)/Grant(s): W-7405-eng-92
Report No.(s): AD-A396840; BMI-970; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The creep-rupture characteristics were determined for commercial 6061-T6 (61S-T6) aluminum alloy at 450 and 500 F. The results are presented as design and creep-rate curves. Stress-rupture strengths at 450 F were 17,000, 13,000, and 9,000 (estimated) psi for rupture in 10, 100, and 1000 hr, respectively. At 500 F, stress-rupture strengths were 10,500, 9,100, and 7,200 (estimated) psi for rupture in 10, 100, and 1000 hr, respectively.

DTIC

*Aluminum Alloys; Creep Rupture Strength; Fracture Mechanics; High Temperature Tests*

**20020018525** Brookhaven National Lab., Upton, NY USA
**Electronic structure of Ag/Cu(100) surface alloys studies by Auger-photoelectron coincidence spectroscopy**
Arena, A.; Bartynski, A.; Hulbert, L.; Oct. 08, 2001; 12p; In English
Report No.(s): DE2001-787623; BNL-68659; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have measured the Ag and Pd M(sub 5)VV Auger spectrum in coincidence with Ag and Pd 4d(sub 5/2) photoelectrons for the Ag/Cu(100) and Pd/Cu(100) systems, respectively, as a function of admetal coverage. These systems form surface alloys (i.e. random substitutional alloys in the first atomic layer) for impurity concentrations in the 0.1 monolayer range. For these systems, the centroid of the impurity 4d levels is expected to shift away from the Fermi level by (approx)1 eV, an effect that should be easily seen in coincidence core-valence-valence Auger spectra. We find that the impurity Auger spectra of both systems shift in a manner that is consistent with d-band moving away from EF. However, the shift for Pd is considerably smaller than expected, and a shift almost absent for Ag. The disagreement between theory and experiment is most likely caused by the neglect of lattice relaxations in the calculations.

NTIS

*Electronic Structure; Silver Alloys; Copper Alloys; Photoelectron Spectroscopy; Auger Spectroscopy*

**20020018610** National Bureau of Standards, Gaithersburg, MD USA
**Tensile and Impact Properties of Selected Materials from 20 to 300 K**
Warren, K. A.; Reed, R. P.; Jun. 28, 1963; 57p; In English
Report No.(s): AD-A397019; NBS-M-63; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The tensile and impact properties of structural materials experimentally determined at temperatures from 20 to 300 K. Tensile properties of a few materials were also determined at 4 K. The materials included forty-two commercial alloys of iron, aluminum, titanium, copper, nickel and cobalt, and two metal-bonded carbides. The properties experimentally determined were the yield strength, tensile strength, elongation and reduction of arch, the stress versus strain curve, and the impact energy. The test equipment and procedures are described. The individual data are presented in tables, and the average results are displayed in graphs.

Author

*Tensile Strength; Impact Tests; Yield Strength; Elongation; Tensile Properties; Stress-Strain Relationships*

**20020018823** NASA Glenn Research Center, Cleveland, OH USA

**Evaluation of Ti-48Al-2Cr-2Nb Under Fretting Conditions**

Miyoshi, Kazuhisa, NASA Glenn Research Center, USA; Lerch, Bradley A., NASA Glenn Research Center, USA; Draper, Susan L., NASA Glenn Research Center, USA; Raj, Sai V., NASA Glenn Research Center, USA; November 2001; 20p; In English; Third International Symposium on Fretting Fatigue, 15-18 May 2001, Nagaokashi, Japan; Sponsored by American Society for Testing and Materials, Unknown

Contract(s)/Grant(s): RTOP 708-24-13

Report No.(s): NASA/TM-2001-211205; NAS 1.15:211205; ASTM-STP-1425; E-13006-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The fretting behavior of Ti-48Al-2Cr-2Nb (y-TiAl) in contact with the nickel-base superalloy 718 was examined in air at temperatures from 296 to 823 K (23 to 550 C). The interfacial adhesive bonds between Ti-48Al-2Cr-2Nb and superalloy 718 were generally stronger than the cohesive bonds within Ti-48Al-2Cr-2Nb. The failed Ti-48Al-2Cr-2Nb debris subsequently transferred to the superalloy 718. In reference experiments conducted with Ti-6Al-4V against superalloy 718 under identical fretting conditions, the degree of transfer was greater for Ti-6A1-4V than for Ti-48Al-2Cr-2Nb. Wear of Ti-48Al-2Cr-2Nb generally decreased with increasing fretting frequency. The increasing rate of oxidation at elevated temperatures led to a drop in wear at 473 K. However, fretting wear increased as the temperature was increased from 473 to 823 K. At 723 and 823 K, oxide film disruption generated cracks, loose wear debris, and pits on the Ti-48Al-2Cr-2Nb wear surface. Both increasing slip amplitude and increasing load tended to produce more metallic wear debris, causing severe abrasive wear in the contacting metals.

Author

*Aluminum Alloys; Fretting; Heat Resistant Alloys; Nickel Alloys; Niobium Alloys; Titanium Alloys; Vanadium Alloys; Mechanical Properties; Wear*

**20020018861** Helsinki Univ. of Technology, Lab. of Materials Processing and Powder Metallurgy, Espoo, Finland

**Helsinki University of Technology, Laboratory of Material Processing Powder Metallurgy *Annual Report, 1999***

1999; 42p; In English

Report No.(s): PB2001-108107; Copyright; Avail: National Technical Information Service (NTIS)

Contents include the following: preface; personnel; teaching activities; research activities; reaction mechanisms of particles in suspension smelting: copper sulphide oxidation, nickel sulphide oxidation, flue dust sulphation kinetics; process simulation; powder metallurgy; and other projects; publications; lectures; professional excursions and other academic activities; theses; laboratory facilities; and personnel contact information.

NTIS

*Powder Metallurgy; Reaction Kinetics; Research*

**20020019556** Utah Univ., Dept. of Metallurgical Engineering, Salt Lake City, UT USA

**Fatigue of Lamellar Polycrystals in Gamma Titanium Aluminides**

Ravichandran, K. S.; Sep. 10, 2001; 12p; In English

Contract(s)/Grant(s): F49620-00-1-0251; Proj-2306

Report No.(s): AD-A397002; AFRL-SR-BL-TR-01-0604; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study of fatigue damage in lamellar polycrystals of gamma-TiAl based intermetallic alloys have been undertaken. Using electropolished fatigue specimens, it has been found that most of fatigue failures occur due to cracks initiating internally. Surface damage prior to failure has been very minimal. The specimens showed very little change in cyclic stress-strain hysteresis prior to failure. This mechanism of fatigue failure is atypical when compared to most conventional materials, and requires a very careful study both from a fundamental and engineering perspective. A theoretical model was developed to related the microcracks forming in fatigue, to the macroscopic ductility of gamma-TiAl specimens.

DTIC

*Titanium Aluminides; Fatigue (Materials)*

**20020019811** Battelle Memorial Inst., Columbus, OH USA

**Evaluation of Electron-Emission Behavior for Detecting Carbon in Tungsten and Rhenium**

Baker, James B.; Gaines, Gordon B.; Sep. 24, 1963; 22p; In English

Contract(s)/Grant(s): W-7405-ENG-92

Report No.(s): AD-A397095; BMI-1649; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In a program to develop methods of studying high-temperature metal reactions by means of changes in the thermal-electron-emission behavior when such reactions occur, the thermal-electron-emission behavior of rhenium-carbon and

tungsten-carbon alloys was determined. It is shown that the presence of a very small amount of carbon on the surface of rhenium produces an easily detectable increase in the emission current. In the tungsten-carbon system two new emission states were detected. One of these shows emission of a much higher level than that of pure tungsten and appears to occur when the emitting surface is composed of WC. The other shows an emission level slightly lower than that for pure tungsten and appears to occur when the emitting surface is composed of W2C.
DTIC
*Tungsten Alloys; Electron Emission; Thermal Emission; Rhenium Alloys*

**20020020448** Westinghouse Astronuclear Lab., Pittsburgh, PA USA
**Development of High Strength Columbium and Tantalum Alloy Tubing** ***Quarterly Report***
Oct. 11, 1963; 41p; In English
Contract(s)/Grant(s): AT(30-1)3108
Report No.(s): AD-A397256; WANL-PR-(N)-003; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The feasibility of drawing B-66 to tubing was demonstrated. A solid B-66 rod was gun-drilled and then reduced by drawing, 80%, to 0.5 inch 0.D. x 0.062 inch wall tubing at 600 deg F. An attempt to draw B-66 to tubing at room temperature was unsuccessful because of a lubrication failure. This resulted in excessive galling between the die and tube 0.D. from which a crack was initiated. Tube drawing is being done at the facilities of the Superior Tube Company. Extrusion of 69 pounds of B-66 and 142 pounds of T-111 tube blanks at a reduction ratio of 7:1 was accomplish at the facilities of Nuclear Metals, The extrusion constant for the B-66 was 80-81.7 ksi and 76-85.5 ksi for the T-111. The results of the tube blank extrusions verified the data from the extrudability evaluation that were described in the Second Quarterly Progress Report. The B-66 extrusions were conditioned and yielded 43.75 pounds of tube blanks, a 63% recovery of useable material based on the starting extrusion billet weight. The as-conditioned B-66 tube blanks were successfully warm tube reduced 55% from a 2 inch 0.D. x 0.25 inch wall to a 1.375 inch 0.D. x 0.156 inch wall.
DTIC
*B-66 Aircraft; High Strength; Pipes (Tubes); Tantalum Alloys; Niobium*

**20020020963** NASA Langley Research Center, Hampton, VA USA
**Advanced Metallic Thermal Protection System Development**
Blosser, M. L., NASA Langley Research Center, USA; Chen, R. R., Lockheed Martin Space Operations, USA; Schmidt, I. H., Lockheed Martin Space Operations, USA; Dorsey, J. T., NASA Langley Research Center, USA; Poteet, C. C., NASA Langley Research Center, USA; Bird, R. K., NASA Langley Research Center, USA; [2002]; 22p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2002-0504; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche
A new Adaptable, Robust, Metallic, Operable, Reusable (ARMOR) thermal protection system (TPS) concept has been designed, analyzed, and fabricated. In addition to the inherent tailorable robustness of metallic TPS, ARMOR TPS offers improved features based on lessons learned from previous metallic TPS development efforts. A specific location on a single-stage-to-orbit reusable launch vehicle was selected to develop loads and requirements needed to design prototype ARMOR TPS panels. The design loads include ascent and entry heating rate histories, pressures, acoustics, and accelerations. Additional TPS design issues were identified and discussed. An iterative sizing procedure was used to size the ARMOR TPS panels for thermal and structural loads as part of an integrated TPS/cryogenic tank structural wall. The TPS panels were sized to maintain acceptable temperatures on the underlying structure and to operate under the design structural loading. Detailed creep analyses were also performed on critical components of the ARMOR TPS panels. A lightweight, thermally compliant TPS support system (TPSS) was designed to connect the TPS to the cryogenic tank structure. Four 18-inch-square ARMOR TPS panels were fabricated. Details of the fabrication process are presented. Details of the TPSS for connecting the ARMOR TPS panels to the externally stiffened cryogenic tank structure are also described. Test plans for the fabricated hardware are presented.
Author
*Fabrication; Panels; Thermal Protection; Cryogenic Fluid Storage; Creep Analysis*

**20020020974** General Dynamics/Convair, Huntsville, AL USA
**Tips on Fatigue**
Smith, Clarence R.; Jan. 1963; 123p; In English
Report No.(s): AD-A397117; NAVWEPS-00-25-559; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This book proposes to be a guide on how to: (1) Recognize potential fatigue problems; (2) Rectify existing problems; (3) Avoid getting into situations that may cause problems. Principles mentioned herein have to do with: (1) relationships of one structural member to another; and (2) paths of load carried within the individual members.
Derived from text
*Fatigue (Materials); Loads (Forces); Structural Members*

**20020021147** NASA Langley Research Center, Hampton, VA USA
**The Effect of O2, H2O, and N2 on the Fatigue Crack Growth Behavior of an Alpha + Beta Titanium Alloy at 24 C and 177 C**
Smith, Stephen W., NASA Langley Research Center, USA; Piascik, Robert S., NASA Langley Research Center, USA; December 2001; 32p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 706-62-31-01
Report No.(s): NASA/TM-2001-211248; L-18127; NAS 1.15:211248; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To study the effects of atmospheric species on the fatigue crack growth behavior of an a+B titanium alloy (Ti 6-2-2-2-2) at room temperature and 177 C, fatigue tests were performed in laboratory air, ultrahigh vacuum, and high purity water vapor, oxygen, nitrogen and helium at various partial pressures. Accelerated fatigue crack growth rates in laboratory air compared to ultrahigh vacuum are linked to the damaging effects of both water vapor and oxygen. Observations of the fatigue crack growth behavior in ultrahigh purity environments, along with surface film analysis using X-ray photoelectron spectroscopy (XPS), suggest that multiple crack-tip processes govern the damaging effects of air. Three possible mechanisms are proposed: 1) at low pressure (less than 10(exp -1) Pa), accelerated da/dN is likely due to monolayer adsorption on crack-tip surfaces presumably resulting in decreased bond strengths at the fatigue crack tip, 2) for pressures greater than 10(exp -1) Pa, accelerated da/dN in oxygen may result from oxidation at the crack tip limiting reversible slip, and 3) in water vapor, absorption of atomic hydrogen at the reactive crack tip resulting in process zone embrittlement.
Author
*Fatigue Tests; Fatigue (Materials); Crack Propagation; Titanium Alloys; Embrittlement*

**20020021277** National Defence Research Establishment, Avd. foer Vapen och Skydd, Tumba, Sweden
**Study Visit to Japan**
Savage, S. J.; Olsson, L. G.; Lood, L.; Aug. 2000; ISSN 1104-9154; 20p; In English
Report No.(s): PB2002-100660; FOA-R-00-01580-318-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study visit to Japan, including visits to Japan Steel Works Ltd, Okayama University (two faculties) and Kobe Steel Ltd has been made. During the visits we were able to meet senior R&D managers at each of the companies, and research staff at Okayama University, to see and discuss methods for ballistic and high strain rate materials testing. The primary purpose of these visits was to establish contacts, with a view to obtaining small quantities of armor steel and metal matrix composites for testing in Sweden. Special permission to export such materials is required, due to the strict Japanese regulations governing export of defense materiel. We obtained considerable information on the activities at the companies/university we visited, which will be useful in future contacts. A planned visit to Japan Defense Agency could not be made due to delays in the clearance application (outside our control).
NTIS
*Japan; Ballistics; Steels; Mechanical Properties; Technology Transfer*

## 27
## NONMETALLIC MATERIALS

*Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.*

**20020016101** Pacific Northwest National Lab., Richland, WA USA
**Database and Interim Glass Property Models for Hanford HLW Glasses**
Hrma, P. R.; Piepel, G. F.; Vienna, J. D.; Cooley, S. K.; Kim, D.; Jul. 24, 2001; 90p; In English
Report No.(s): DE2001-787351; PNNL-13573; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The purpose of this report is to provide a methodology for an increase in the efficiency and a decrease in the cost of vitrifying high-level waste (HLW) by optimizing HLW glass formulation. This methodology consists in collecting and generating a database

of glass properties that determine HLW glass processability and acceptability and relating these properties to glass composition. The report explains how the property-composition models are developed, fitted to data, used for glass formulation optimization, and continuously updated in response to changes in HLW composition estimates and changes in glass processing technology. Further, the report reviews the glass property-composition literature data and presents their preliminary critical evaluation and screening. Finally the report provides interim property-composition models for melt viscosity, for liquidus temperature (with spinel and zircon primary crystalline phases), and for the product consistency test normalized releases of B, Na, and Li. Models were fitted to a subset of the screened database deemed most relevant for the current HLW composition region.
NTIS
*Data Bases; Glass; Optimization; Mathematical Models; Radioactive Wastes; Mineralogy*

**20020016121** AccuTru International Corp., Kingwood, TX USA
**Development of Advanced Sensor Technologies for the USA Glass Industry - Final Report - 07/20/1995 - 08/19/1999**
Conner, B. L.; Cannon, C.; Dec. 01, 1999; 67p; In English
Report No.(s): DE2001-787907; DOE/ID/13367; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The glass industry, with support from the U.S. Department of Energy (DOE), undertook a project to significantly improve temperature measurement in glass melters, thereby reducing energy usage through improved process control. AccuTru International determined that a new kind of protective sheath would improve the life and range of applications of the temperature measuring thermocouples. In cooperation with Corning, Inc., the University of Missouri-Rolla ceramics department conducted tests on a proprietary alumina sheath technology, which shows significant promise. In addition, AccuTru obtained DOE funding to develop a self-verifying sensor. The new sensor, with alumina sheath, was tested at a Corning facility, and the results exceeded expectations. Areas for additional development efforts were identified.
NTIS
*Temperature Measurement; Sensors; Product Development; Technology Assessment; Industries; Glass Fibers*

**20020016127** Army Tank-Automotive Research and Development Command, Warren, MI USA
**Lab Test of Prototype HMMWV Filter Elements Constructed with Spunbond Polyester Media**
Quaderer, Jamie; Richards, Michael J.; Sierpien, Larry; Margrif, Frank; Jul. 2001; 61p; In English
Report No.(s): AD-A396714; TARDEC-TR-13802; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Lab test results showed the spunbond polyester media met efficiency requirements but failed the dust capacity/service life requirement. The spunbond polyester media achieved an efficiency of 99.88% which exceeds the required 99. 5%. The spunbond polyester media achieved a service life of 3.4 hours during dust capacity tests. This falls way short of meeting the present specified service life requirement of 20 hours (recently Waived to 16 hours in a recent contract). Initial restriction of spunbond polyester media was considered acceptable and only slightly higher in one HMMWV prototype than the two comparison HMMWV production filter elements lab tested. Dust capacity lab test results based on the Army's current test methods and procedures showed the spunbond polyester media would not be considered acceptable for use on military vehicle based on HMMWV air filter test results. Lab test results do not consider vibration effects as would be seen by a filter element installed on a military vehicle. It is not known if spunbond polyester media performance would increase significantly if vibration effects were incorporated during dust capacity tests as measured on vehicle during running.
DTIC
*Polyesters; Air Filters*

**20020016150** Office of Naval Research, Arlington, VA USA
**Program and Abstracts of the First International Workshop on Amorphous and Nanostructured Chalcogenides - Fundamentals and Applications Held in Bucharest, Romania on June 25-28, 2001**
Jun. 28, 2001; 121p; In English
Report No.(s): AD-A396765; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This document provides programs and abstracts of the 1st International Workshop on Amorphous and Nanostructured Chalcogenides held in Bucharest, Romania on 25-28 June 2001. This workshop is intended to be a forum for discussion and exchange of ideas and results on properties and phenomena related to non-crystalline chalcogenides. It is aimed at physicists, chemists, and material scientists interested in this field. Some topics discussed are: state of the art in physics and chemistry of non-crystalline chalcogenides, new developments in nanostructured chalcogenides, nanocrystalline chalcogenides versus

amorphous chalcogenides, modern devices for optoelectronics, chalcogenides and glass science, and other glasses as partners of the chalcogenides glasses.
DTIC
*Electro-Optics; Materials; Crystallinity; Chalcogenides*

**20020016151** Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA
**A Fire-Resistant Epoxy *Final Report***
Lyon, Richard E.; Castelli, Lauren M.; Walters, Richard; Aug. 2001; 18p; In English
Report No.(s): AD-A396763; DOT/FAA/AR-01/53; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The flammability, thermomechanical properties, and fire response of the diglycidylether of 1,1 -dichloro-2,2-bis(4-hydroxyphenyl)ethylene (DGEBC) cured with several hardeners were examined and compared to diglycidylether of bisphenol-A (DGEBA) systems. The DGEBC and DGEBA were cured with (1) triethylenetetramine, (2) methylenedianiline, (3) the parent phenol (BPC or BPA), (4) catalytic amounts of (2-ethyl-4-methylimidazole) (EMI-24), and (5) the dicyanate of bisphenol-C. Cured samples were measured for strength, modulus, flame resistance (limiting oxygen index (LOI), UL-94 V), flaming heat release rate, and heat release capacity. The mechanical properties of the DGEBC and DGEBA systems were equivalent but the DGEBC systems exhibited superior flame resistance and 50% lower heat release rate and heat release capacity than the corresponding DGEBA system. The DGEBC cured with methylenedianiline had an LOI of 30-31, exhibited UL 94 V-O/5V behavior and easily passed the Federal Aviation Administration heat release requirement Federal Aviation Regulation 25.853 (a-l) as a single-ply glass fabric lamina.
DTIC
*Epoxy Resins; Flammability; Fires; Heat Transfer; Flame Retardants*

**20020016154** Defence Research Establishment Valcartier, Valcartier, Quebec Canada
**Synthesis of Energetic Polyester Thermoplastic Homopolymers and Energetic Thermoplastic Elastomers Formed Therefrom**
Ampierman, G.; Brochu, S.; Desjardins, M.; Nov. 2001; 44p; In English
Report No.(s): AD-A396755; DREV-TR-2001-175; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For many years, DREV has been involved in the synthesis of energetic thermoplastic elastomers (ETPEs) based on linear glycidyl azide polymer (GAP). These polymers are physically-crosslinked rubbery materials that can be melted, dissolved or recycled and could provide a new generation of binders. Since ETPEs are recyclable, disposal of the formulations at the end of their life cycle will be less problematic. Work at DREV led to the preparation of a new thermoplastic segment. The polymerization of a-bromomethyl-a-methyl-Beta -propiolactone (BMMPL) or a-chloromethyl-a-methyl-J3 - propiolactone (CMMPL) yielded thermoplastic homopolymers that upon azidation led to a novel energetic thermoplastic polyester: poly (a-azidomethyl-a-methyl-Beta- propiolactone) (PAMMPL). An energetic copolyether-ester thermoplastic elastomer was prepared by using glycidyl azide polymer as a macroinitiator for the polymerization of BMMPL or CMMPL. The azidation of the resulting copolyether-ester yielded an energetic thermoplastic elastomer that melted at 80-850C. Polymerization of the o:-dibromomethyl-Beta-propiolactone (DBMPL) resulted in a polymer which upon azidation yielded a new energetic polymer that can be used as a binder or into an energetic thermoplastic elastomer synthesis. This report describes mainly the synthesis and the characterization of these new ETPEs.
DTIC
*Elastomers; Thermoplastic Resins; Thermoplasticity; Polymerization; Glycidyl Azide Polymer*

**20020016208** Sandia National Labs., Albuquerque, NM USA
**Filling Source Feedthrus with Alumina/Molybdenum CND50 Cermet: Experimental, Theoretical, and Computational Approaches**
Stuecker,; Cesarano,; Corral,; Shollenberger,; Roach,; Jul. 01, 2001; 51p; In English
Report No.(s): DE2001-783092; SAND2001-1821; No Copyright; Avail: Department of Energy Information Bridge

This report is a summary of the work completed in FY00 for science-based characterization of the processes used to fabricate cermet vias in source feedthrus. In particular, studies were completed to characterize the CND50 cermet slurry, characterize solvent imbibition, and identify critical via filling variables. These three areas of interest are important to several processes pertaining to the production of neutron generator tubes. Rheological characterization of CND50 slurry prepared with 94ND2 and Sandi94 primary powders were also compared. The 94ND2 powder was formerly produced at the GE Pinellas Plant and the Sandi94 is the new replacement powder produced at CeramTec. Processing variables that may effect the via-filling process were also studied and include: the effect of solids loading in the CND50 slurry; the effect of milling time; and the effect of Nuosperse

(a slurry 'conditioner'). Imbibition characterization included a combination of experimental, theoretical, and computational strategies to determine solvent migration though complex shapes, specifically vias in the source feedthru component. Critical factors were determined using a controlled set of experiments designed to identify those variables that influence the occurrence of defects within the cermet filled via. These efforts were pursued to increase part production reliability, understand selected fundamental issues that impact the production of slurry-filled parts, and validate the ability of the computational fluid dynamics code, GOMA, to simulate these processes. Suggestions are made for improving the slurry filling of source feedthru vias.
NTIS
*Cermets; Characterization; Rheology; Slurries*

**20020016261** Army Tank-Automotive Research and Development Command, Warren, MI USA
**Field Demonstration for Biodegradable Military Multipurpose Grease**
Rhee, In-Sik; Oct. 2001; 43p; In English
Report No.(s): AD-A396703; TARDEC-TR-13804; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Soils and ground water at many military facilities throughout the United States have been contaminated with petroleum-based products, such as engine oils, greases, hydraulic fluids, and fuels, often as a consequence of leakage, accidental spills, or equipment breakdown during active use or storage. The generation of hazardous waste by petroleum, oils, and lubricant (POL) products results in both short and long term liability in terms of costs, environmental damage, and mission performance. For this reason, the military is currently soliciting a new technology that can be used to minimize the waste stream of these products. As a part of this program, a biodegradable lubricating grease (BLG) was successfully developed to replace the conventional petroleum based military automotive greases. This product has been fully evaluated both in the laboratory and under field operational environments. It provides an excellent biodegradability and performance that can meet the military global operational requirements. This paper presents the results of development of military biodegradable greases, laboratory biodegradation tests, and field demonstrations including bioremediation tests.
DTIC
*Biodegradability; Contamination; Greases; Hazardous Wastes; Environment Protection*

**20020016270** Imperial Coll. of Science and Technology, London UK
**Report on International Conference on "Innovative/Cost-Effective Materials Processing Methods - Films and Nanocrystalline Powders"**
Jul. 07, 2000; 11p; In English; Report on International Conference on Innovative/Cost-Effective Materials Processing Methods-Films & Nanocrystalline Powders held 6-7 Jul 2000, Imperial College, London
Report No.(s): AD-A396601; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On July 6, 2000, Dr. K. L. Choy welcomed over 35 delegates from ten countries including UK, USA, France, Germany, Switzerland, Denmark, Poland, the Netherlands, Russia, Spain to ICMPM (Innovative/Cost-Effective Materials Processing Methods) conference at Imperial College. The venue was held at the Dept. of Materials in the Royal School of Mines. This was followed by an official welcome addressed by the Dean of the Royal School of Mines, Prof. John Kilner. As the use of advanced engineering ceramic films and powders for structural and functional applications is expanding rapidly, improved materials and innovative methods of fabrication are needed to enhance the engineering performance and reduce the production costs. Therefore the aim of the ICMPM conference was to bring together international engineer and material scientists concerned with the innovative/cost-effective materials processing methods, at a mature production stage and also in development. Issues and strategies associated with scaling-up were also highlighted. Modelling of deposition techniques and properties were also presented. Advanced on-line/in-situ process monitoring techniques were reported by several speakers. Ten invited papers and seven posters covering a wide variety of novel and/or cost effective synthesis of nanoparticles, films and their applications were presented and discussed. The poster session had facilitated informal discussions between the authors and conference delegates.
DTIC
*Coatings; Powder (Particles); Conferences; Research and Development; Materials Science; Engineering*

**20020016373** National Renewable Energy Lab., Golden, CO USA
**Energy Saving Method of Manufacturing Ceramic Products from Waste Glass: Inventions and Innovation Glass Project Fact Sheet**
Jan. 17, 2001; 2p; In English
Report No.(s): DE2001-783546; DOE/GO-102001-1035; NREL/FS-810-28261; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Project fact sheet written for the Inventions and Innovation Program about a new manufacturing method for producing ceramic products from waste glass.
NTIS
*Ceramics; Glass; Manufacturing*

**20020016393** Princeton Univ., Plasma Physics Lab., NJ USA
**Screening of Hydrocarbon Sources in JET**
Strachan, J. D.; Fundamenski, W.; Charlet, M.; Erents, K.; Gafert, J.; Jun. 15, 2001; 8p; In English
Report No.(s): DE2001-787635; PPPL-3579; No Copyright; Avail: Department of Energy Information Bridge
Carbon is the principal impurity in the Joint European Torus (JET). Methane screening experiments quantify the ability of the scrape-off layer (SOL)/divertor system to ionize carbon and transport it to the divertor, preventing core plasma contamination. Previous JET publications studied edge-localized-mode-averaged high-confinement mode screening, and separately evaluated the methodology of low-confinement mode (L-mode) screening measurements. This paper extends the L-mode measurements to include relevant plasma parameter scans and DIVIMP modeling of the L-mode screening.
NTIS
*Carbon; Impurities; Joint European Torus; Plasma Control*

**20020016397** National Renewable Energy Lab., Golden, CO USA
**Low-Energy Alternative to Commercial Silica-Based Glass Fibers: Inventions and Innovation Glass Project Fact Sheet**
Wogsland, J.; Jan. 17, 2001; 2p; In English
Report No.(s): DE2001-783550; DOE/GO-102001-1140; NREL/FS-810-29270; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Project fact sheet written for the Inventions and Innovation Program about a new low-energy alternative to creating glass fibers for use in creating boats, vehicles, and aircraft.
NTIS
*Fibers; Silica Glass*

**20020016401** Federal Energy Technology Center, Morgantown, WV USA
**CO2 Selective Ceramic Membrane for Water-Gas Shift Reaction with Concomitant Recovery of CO2**
Jul. 19, 2001; 14p; In English
Report No.(s): DE2001-784609; FC26-00NT40922-05; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Presently we have focused on the membrane synthesis, hydrotalcite surface and transport mechanism characterization, and quantitative measurement on CO(sub 2) reversibility. This quarterly report presents the results from the surface characterization study. FTIR, DRIFTS and TGA/MS have been used to quantitatively characterize the thermal behavior of hydrotalcite materials. Based upon these characterization results, a thermal evolution pattern accounting for the loss of interlayer water, hydroxyl group, and CO(sub 2) is proposed for the hydrotalcite we studied. According to the DRIFTS results, a small amount of CO(sub 2) release ((approximately)2wt%) was observed at (approximately)220 C, while the remaining releases at (approximately)450 C. TGA/MS result is consistent with the amount and the temperature region estimated from DRIFTS. Both regions are possible candidates for transport of CO(sub 2) in a membrane configuration. In the next quarter, we will conduct adsorption/desorption study to verify the reversibility of the CO(sub 2) released from these two regions.
NTIS
*Ceramics; Membranes; Carbon Dioxide; Infrared Spectra*

**20020016419** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Effects of annealing on self-assembled InAs quantum dots and wetting layer in GaAs matrix**
Jasinski, J.; Babinski, A.; Bozek, R.; Szepielow, A.; Baranowski, J. M.; Apr. 18, 2001; 6p; In English
Contract(s)/Grant(s): PCSR-7T08A04017
Report No.(s): DE2001-783742; LBNL-47765; No Copyright; Avail: Department of Energy Information Bridge
Post-growth thermal annealing effects on InAs/GaAs quantum dots (QDs) near Stransky-Krastanow transformation were investigated. Self-assembled QDs of average size of about 10 nm were grown by metalorganic vapour phase epitaxy. The photoluminescence (PL) due to emission from QDs as well as two peaks due to emission from the strained InAs wetting layer (WL) were observed in as-grown samples. Bimodal structure of the WL PL was attributed to WL regions of different thickness. There was almost no difference in the PL spectrum after 30 s annealing at 600 C. However, annealing at temperatures in the range

between 700 C and 950 C resulted in quenching of the PL from QDs and the thinner WL. The PL peak from the new, thicker WL blue-shifted and narrowed with increasing annealing temperature. This behavior was in agreement with TEM observations. Complete dissolution of the QDs and substantial broadening of the WL was observed. All our results indicate that thermally induced modifications of the WL rather than QDs can be responsible for the blue-shift and narrowing of the PL peaks in structures containing InAs QDs.
NTIS
*Annealing; Indium Arsenides; Gallium Arsenides; Quantum Dots*

**20020016496** NASA Ames Research Center, Moffett Field, CA USA
**The Pressure Sensitive Paint Method: An Overview**
McLachlan, B. G., NASA Ames Research Center, USA; Bell, J. H., NASA Ames Research Center, USA; [1995]; 1p; In English; American Helicopter Society Technical Specialists Meeting on Vertical Lift Aircraft Design, 18-20 Jan. 1995, San Francisco, CA, USA; Sponsored by American Helicopter Society, Inc., USA
Contract(s)/Grant(s): RTOP 505-59-53; No Copyright; Avail: Issuing Activity; Abstract Only

Pressure sensitive paint (PSP) is a relatively new aerodynamic measurement method with the unique capability of providing a field measurement of pressure over a test surface. This presentation provides an introductory description of this technology based on a review of the open literature. It confines itself to the application of the method to aircraft development wind tunnel testing, at present the primary application area and thus research focus of the method. Described are PSP fundamentals, the various technology elements comprising PSP technology, and current limitations and considerations in applying the technology. Experimental results are presented to illustrate the present capability of the method.
Author
*Pressure Sensitive Paints; Pressure Measurement; Analyzers*

**20020016712** NASA Langley Research Center, Hampton, VA USA
**The Effects of Shot and Laser Peening on Fatigue Life and Crack Growth in 2024 Aluminum Alloy and 4340 Steel**
Everett, R. A., Jr., Army Research Lab., USA; Matthews, W. T., Army Research Lab., USA; Prabhakaran, R., Old Dominion Univ., USA; Newman, J. C., Jr., NASA Langley Research Center, USA; Dubberly, M. J., Dubberly (M. J.), Inc., USA; December 2001; 23p; In English
Contract(s)/Grant(s): RTOP 706-61-11-03
Report No.(s): NASA/TM-2001-210843; NAS 1.15:210843; ARL-TR-2363; L-18065; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fatigue and crack growth tests have been conducted on 4340 steel and 2024-T3 aluminum alloy, respectively, to assess the effects of shot peening on fatigue life and the effects of shot and laser peening on crack growth. Two current programs involving fixed and rotary-wing aircraft will not be using shot peened structures. Since the shot peening compressive residual stress depth is usually less than the 0.05-inch initial damage tolerance crack size, it is believed by some that shot peening should have no beneficial effects toward retarding crack growth. In this study cracks were initiated from an electronic-discharged machining flaw which was cycled to produce a fatigue crack of approximately 0.05-inches in length and then the specimens were peened. Test results showed that after peening the crack growth rates were noticeably slower when the cracks were fairly short for both the shot and laser peened specimens resulting in a crack growth life that was a factor of 2 to 4 times greater than the results of the average unpeened test. Once the cracks reached a length of approximately 0.1-inches the growth rates were about the same for the peened and unpeened specimens. Fatigue tests on 4340 steel showed that the endurance limit of a test specimen with a 0.002-inch-deep machining-like scratch was reduced by approximately 40 percent. However, if the ”scratched” specimen was shot peened after inserting the scratch, the fatigue life returned to almost 100 percent of the unflawed specimens original fatigue life.
Author
*Aluminum Alloys; Crack Propagation; Fatigue Life; Steels; Lasers; Aircraft Configurations; Shot Peening*

**20020017400** Johns Hopkins Univ., School of Medicine, Baltimore, MD USA
**Therapeutic and Chemopreventive Actions of a Novel Polyamine Analog Against Breast Cancer** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***
Davidson, Nancy E.; Sep. 2001; 7p; In English
Contract(s)/Grant(s): DAMD17-99-1-9231
Report No.(s): AD-A396921; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The intracellular polyamines, spermidine, spermine, and putrescine, play an important role in the proliferation and death of normal and malignant cells. As a consequence, our work has focused on development of inhibitors of this metabolic pathway. A

phase II trial of diethylnorspermine (DENSpm) for women with advanced breast cancer has enrolled 16 patients. Analysis of clinical outcome is in progress and no excessive toxicity has been observed. Collection of DENSpm- and control-treated breast cancer tissues derived from discarded mastectomy tissues has continued. Testing of polyamine analogs as treatment for established breast cancer is in progress using the nude mouse xenograft model. Proposed chemoprevention studies will begin as soon as the therapy studies are complete.
DTIC
*Toxicity; Chemotherapy; Mammary Glands; Cancer*

**20020017466** National Defence Research Establishment, Umea, Sweden
**Summary Report. Adsorption Kinetics of Mixture Systems on Activated Carbon Beds**
Wu, J.; Claesson, O.; Faengmark, I.; Feb. 2001; 18p; In English
Report No.(s): PB2001-108493; FOI-R-0034-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Adsorption phenomena in such fields as purification and separation of gases, recovery of industrial solvents and respiratory protection is concerned with mixtures. Understanding the adsorption kinetics of mixtures of organic vapors on activated carbon beds is the key step in evaluating the service life of a filter. The adsorption kinetics and the shapes of the breakthrough curves can be divided into two different situations. One is where no displacement between the components take place, and where the components usually have similar adsorbabilities. In this case the Wheeler-Dubinin where the components usually have similar adsorbabilities. In this case the Wheeler-Dubinin model can be used to predict the breakthrough curves of the components from the adsorption isotherms of the pure components. The other situation is that displacement exists while one component in the mixture is more strongly adsorbed than the other. The mathematical method to predict the breakthrough curves for this case has been developed by Nadar Vadhat et al. It is described in this report. There are, however, some limitations to this method. There is still a lot of work to be done in order to improve the predictive power of the model as well as to develop a semi empirical model which takes the humidity into consideration.
NTIS
*Activated Carbon; Adsorption; Kinetics*

**20020017470** National Defence Research Establishment, Tumba, Sweden
**Kemisk Omvandling av FOX. 1. Reaktion Mellan FOX-7 och Aminer (Chemical Conversion of FOX-7. 1. The Reaction between FOX-7 and Amines)**
Bellamy, A.; Dec. 2000; 26p; In Swedish
Report No.(s): PB2001-108438; FOA-R-00-01727-310-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The reaction of FOX-7 with different amines has been studied. FOX-7 reacts with simple primary and secondary amines thereby producing N-alkyl-1,1-diamino 2,2-dinitroethene and even N,N'-dialkyl-1,1- diamino-2,2-dinitroethene. When FOX-7 was reacted with alpha(w with bar)-diamines cyclic derivatives where mainly formed. Attempts were made to react FOX-7 with polymeric polyamines but no new products could be isolated.
NTIS
*Polymerization; Amines; Alkyl Compounds; Diamines*

**20020017521** NASA Marshall Space Flight Center, Huntsville, AL USA
**Thermal and Chemical Characterization of Non-metallic Materials Using Coupled Thermogravimetric Analysis and Infrared Spectroscopy**
Huff, Timothy L., NASA Marshall Space Flight Center, USA; [2001]; 8p; In English; Thermal and Fluid Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Thermogravimetric analysis (TGA) is widely employed in the thermal characterization of non-metallic materials, yielding valuable information on decomposition characteristics of a sample over a wide temperature range. However, a potential wealth of chemical information is lost during the process, with the evolving gases generated during thermal decomposition escaping through the exhaust line. Fourier Transform-Infrared spectroscopy (FT-IR) is a powerful analytical technique for determining many chemical constituents while in any material state, in this application, the gas phase. by linking these two techniques, evolving gases generated during the TGA process are directed into an appropriately equipped infrared spectrometer for chemical speciation. Consequently, both thermal decomposition and chemical characterization of a material may be obtained in a single sample run. In practice, a heated transfer line is employed to connect the two instruments while a purge gas stream directs the evolving gases into the FT-IR, The purge gas can be either high purity air or an inert gas such as nitrogen to allow oxidative and pyrolytic processes to be examined, respectively. The FT-IR data is collected real-time, allowing continuous monitoring of chemical compositional changes over the course of thermal decomposition. Using this coupled technique, an array of diverse materials has been examined,

including composites, plastics, rubber, fiberglass epoxy resins, polycarbonates, silicones, lubricants and fluorocarbon materials. The benefit of combining these two methodologies is of particular importance in the aerospace community, where newly developing materials have little available data with which to refer. by providing both thermal and chemical data simultaneously, a more definitive and comprehensive characterization of the material is possible. Additionally, this procedure has been found to be a viable screening technique for certain materials, with the generated data useful in the selection of other appropriate analytical procedures for further material characterization.
Author
*Thermal Decomposition; Thermogravimetry; Chemical Composition; Characterization; Infrared Spectroscopy; Ablative Materials*

**20020018126** Federal Energy Technology Center, Morgantown, WV USA
**Improvement of wear component's performance by utilizing advanced materials and new manufacturing technologies: castcon process for mining applications**
Huang, X.; Gertsch, R.; Jul. 27, 2001; 3p; In English
Report No.(s): DE2001-785195; FC26-01NT41055-02; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A tungsten carbide monolithic preform was produced by Advanced Ceramics. MTU conducted various sintering tests on the preform to determine conditions for removing the organic binder and improving the mechanical properties. The originally selected parameters for sintering did not perform as anticipated and further testing is underway.
NTIS
*Tungsten Carbides; Ceramics; Sintering*

**20020018131** Brookhaven National Lab., Upton, NY USA
**What Is the Color Glass Condensate?**
McLerran,; May 08, 2001; 12p; In English
Report No.(s): DE2001-785048; BNL-68528; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The author describes the color glass condensate and its importance for a variety of problems related to small-x physics.
NTIS
*Color; Condensates; Glass*

**20020018145** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
**Adhesive Bonding Performance of Aerospace Materials Prepared With Alternative Solvents** ***Final Report, Oct. 1999-Sep. 2000***
Grendahl, Scott M.; Chin, Wai K.; Isaac, Clinton; Nov. 2001; 52p; In English
Contract(s)/Grant(s): DA Proj. 02J80015
Report No.(s): AD-A396875; ARL-TR-2614; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The purpose of this work was to identify a suitable, environmentally friendly maintenance chemical to replace methyl ethyl ketone (MEK), a standard solvent currently utilized for adhesive bonding of metal substrates. MEK was used as a baseline reference maintenance chemical for this project. The effectiveness of three environmental friendly replacement candidate compounds were evaluated under the repair simulation guidelines of the Aeronautical Design Standard Performance Specification for Cleaners, Aqueous and Solvent, for Army Aircraft (U.S. Army Aviation and Missile Command. 'Aeronautical Design Standard Performance Specification for Cleaners, Aqueous and Solvent, for Army Aircraft'. ADS-61-PRF, Draft, Aviation Engineering Directorate, Redstone Arsenal, AL, 16 May 2000), and the Standard Test Method for Floating Roller Peel Resistance of Adhesives, ASTM-D3 167-93 (American Society for Testing and Materials. 'Standard Test Method for Floating Roller Peel Resistance of Adhesives'. ASTM D3 167-93, West Conshohocken, PA, 1993). Four metal substrates (AM-355 stainless steel, electroformed nickel plated steel, aluminum 7075-T6 bare, and titanium 6A1-4V) and four chemicals (identified as MEK, normalized propylbromide NPB, Vertec Gold, and HFE 71DE) were utilized. The adhesive utilized in the layup of the test specimens was the two-part epoxy paste system-Dexter Hysol EA 9309.3NA. The results indicated that the best replacement candidates were Vertec Gold, an ethyl lactate-based cleaner, and HFE 71DB, a solvent-based cleaner.
DTIC
*Adhesive Bonding; Solvents; Epoxy Resins; Spacecraft Construction Materials; Aluminum Alloys; Aeronautical Engineering*

**20020018162** Thiokol Propulsion, Brigham City, UT USA

**Methodology for Evaluating Raw Material Changes to RSRM Elastomeric Insulation Materials**

Mildenhall, Scott D., Thiokol Propulsion, USA; [2001]; 12p; In English; 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS8-38100

Report No.(s): AIAA Paper 2001-3281; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Reusable Solid Rocket Motor (RSRM) uses asbestos and silicon dioxide filled acrylonitrile butadiene rubber (AS-NBR) as the primary internal insulation to protect the case from heat. During the course of the RSRM Program, several changes have been made to the raw materials and processing of the AS-NBR elastomeric insulation material. These changes have been primarily caused by raw materials becoming obsolete. In addition, some process changes have been implemented that were deemed necessary to improve the quality and consistency of the AS-NBR insulation material. Each change has been evaluated using unique test efforts customized to determine the potential impacts of the specific raw material or process change. Following the evaluations, the various raw material and process changes were successfully implemented with no detectable effect on the performance of the AS-NBR insulation. This paper will discuss some of the raw material and process changes evaluated, the methodology used in designing the unique test plans, and the general evaluation results. A summary of the change history of RSRM AS-NBR internal insulation is also presented.

Author

*Reusable Rocket Engines; Insulation; Silicon Dioxide; Technology Assessment*

**20020018175** Sandia National Labs., Albuquerque, NM USA

**Pulsed Dielectric Breakdown of Aluminum Oxide (ALOX) Filled Epoxy Encapsulants: Effects of Formulation and Electric Stress Concentration**

Anderson, R. A.; Lagasse, R. R.; Schroeder, J. L.; Zeuch, D. H.; Montgomery, S. T.; Sep. 01, 2001; 30p; In English

Report No.(s): DE2001-787611; SAND2001-2897; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Aluminum oxide (ALOX)-filled epoxy is the dielectric encapsulant in shock driven high voltage power supplies. ALOX encapsulants display a high dielectric strength under purely electrical stress, but minimal information is available on the combined effects of high voltage and mechanical shock. We report breakdown results from applying electrical stress in the form of a unipolar high-voltage pulse of the order of 10 (micro)s duration, and our findings may establish a basis for understanding the results from proposed combined-stress experiments. A test specimen geometry giving approximately uniform fields is used to compare three ALOX encapsulant formulations, which include the new baseline 459 epoxy resin encapsulant and a variant in which the Alcoa T-64 alumina filler is replaced with Sumitomo AA-10 alumina. None of these encapsulants show a sensitivity to ionizing radiation. We also report results from specimens with sharp-edged electrodes that cause strong, localized field enhancement as might be present near electrically-discharged mechanical fractures in an encapsulant. Under these conditions the 459-epoxy ALOX encapsulant displays approximately 40% lower dielectric strength than the older Z-cured Epon 828 formulation. An investigation of several processing variables did not reveal an explanation for this reduced performance. The 459-epoxy encapsulant appears to suffer electrical breakdown if the peak field anywhere reaches a critical level. The stress-strain characteristics of Z-cured ALOX encapsulant are measured under high triaxial pressure and we find that this stress causes permanent deformation and a network of microscopic fractures. Recommendations are made for future experimental work.

NTIS

*Epoxy Compounds; Aluminum Oxides; Dielectrics; Encapsulating*

**20020018177** Sandia National Labs., Albuquerque, NM USA

**Multicomponent-Multiphase Equation of State for Carbon**

Kerley, G. I.; Chhabildas, L. C.; Sep. 01, 2001; 50p; In English

Report No.(s): DE2001-787608; SAND2001-2619; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The unique properties of carbon have made it both a fascinating and an important subject of experimental and theoretical studies for many years. The contrast between its best-known elemental forms, graphite and diamond, is particularly striking. Graphite is black, has a rather low density and high compressibility (close to that of magnesium), and is greasy enough to be useful as a lubricant and in pencil leads. Diamond is brilliantly translucent, 60% more dense than graphite, less compressible than either tungsten or corundum, and its hardness makes it useful for polishing and cutting. This variability in properties, as well as that observed among the many classes of carbon compounds, arises because of profound differences in electronic structure of the carbon bonds. A number of other solid forms of carbon are known. Pyrolytic graphite is a polycrystalline material in which the individual crystallites have a structure quite similar to that of natural graphite. Fullerite (solid C 60), discovered only ten years

ago, consists of giant molecules in which the atoms are arranged into pentagons and hexagons on the surface of a spherical cage. Amorphous carbon, including carbon black and ordinary soot, is a disordered form of graphite in which the hexagonally bonded layers are randomly oriented. Glassy carbons, on the other hand, have more random structures. Many other structures have been discussed.
NTIS
*Carbon; Equations of State*

**20020018884** Alabama A & M Univ., Center for Irradiation of Materials, Normal, AL USA
**Palladium Implanted Silicon Carbide for Hydrogen Sensing**
Muntele, C. I., Alabama A & M Univ., USA; Ila, D., Alabama A & M Univ., USA; Zimmerman, R. L., Alabama A & M Univ., USA; Muntele, L., Alabama A & M Univ., USA; Poker, D. B., Alabama A & M Univ., USA; Hensley, D. K., Alabama A & M Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 11; In English; Also announced as 20020018881
Report No.(s): P3; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Silicon carbide is intended for use in fabrication of high-temperature, efficient hydrogen sensors. Traditionally, when a palladium coating is applied on the exposed surface of SiC, the chemical reaction between palladium and hydrogen produces a detectable change in the surface chemical potential. We have produced both a palladium coated SiC as well as a palladium, ion implanted SiC sensor. The palladium implantation was done at 500 C into the Si face of 6H, N-type SiC at various energies, and at various fluences. Then, we measured the hydrogen sensitivity response of each fabricated sensor by exposing them to hydrogen while monitoring the current flow across the p-n junction(s), with respect to time. The sensitivity of each sensor was measured at temperatures between 27 and 300 C. The response of the SiC sensors produced by Pd implantation has revealed a completely different behaviour than the SiC sensors produced by Pd deposition. In the Pd-deposited SiC sensors as well as in the ones reported in the literature, the current rises in the presence of hydrogen at room temperature as well as at elevated temperatures. In the case of Pd-implanted SiC sensors, the current decreases in the presence of hydrogen whenever the temperature is raised above 100 C. We will present the details and conclusions from the results obtained during this meeting.
Author
*Silicon Carbides; Palladium; Ion Implantation; Deposition; Hydrogen*

**20020018906** NASA Glenn Research Center, Cleveland, OH USA
**UV Curable Polyimides**
Meador, Michael, NASA Glenn Research Center, USA; Oliver, Thomas, Prairie View Agricultural and Mechanical Coll., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 33; In English; Also announced as 20020018881
Report No.(s): P25; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The development of UV curable polyimides for high-temperature applications is a growing area of research activity. The objective of this technology is an attempt to bypass many of the issues associated with ”typical” high-temperature polymers. For example, the use of toxic or mutagenic monomers (i.e., many aromatic diamines) can be prevented. Also, it proves to be a viable means in circumventing the problems associated with high-processing temperature of polymers, which cause thermally induced processing stresses (i.e., microcracking). The approach that we have been pursuing is Diels-Alder Polymerization. In this approach, we are generating dienes with light instead of heat. This process is called photoenolization. Several bismaleimides and bisacrylates are used as the dienophiles. The method is fairly general and a wide variety of diketones and bismaleimides can be used. UV curability processes are advantageous due to the following: (1) With such a wide variety of monomers, it allows for the use of nontoxic/nonmutagenic monomers; (2) Polyimides cure at room temperature, which reduces thermally induced stresses; (3) It reduces processing and tooling cost; (4) There are many potential applications for this technology, i.e., thin films as alignment layers for LC displays, photoresists, and photonic material as well as a potential market for use as adhesives.
Author
*Curing; Ultraviolet Radiation; Polyimides; Diels-Alder Reactions; Polymerization*

**20020018911** Tuskegee Inst., Dept. of Mechanical Engineering, AL USA
**Polyimide Based Nanocomposites for Affordable Space Transport**
Dean, Derrick, Tuskegee Inst., USA; Islam, Mohsina, Tuskegee Inst., USA; Small, Sharee, Tuskegee Inst., USA; Aldridge, Brandon, Tuskegee Inst., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 38; In English; Also announced as 20020018881
Report No.(s): P30; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In setting forth its strategic plan, NASA has indicated that low-cost access to space is the key to unleashing the commercial potential of space and greatly expanding space research and exploration. The development of advanced materials will be an enabling technology for this quest for low-cost space access. In this research program, we are attempting to address the need for new advanced materials by developing high-performance nanodispersed inorganic/organic and organic/organic polyimide composites utilizing specific interactions. Our goal is to systematically manipulate these interactions and investigate the resulting processing morphology-property relationships. Specifically, we will investigate three main parameters on these relationships. These include (1) the type of polyimide; (2) the structure of the inorganic nanoparticle being used; and (3) manipulation of the interfacial energy. During the first year of this effort, we have demonstrated the successful synthesis of PMR-15/layered silicate nanocomposites. Morphological studies indicate that exfoliated structures were obtained in most instances, with a mixture of exfoliated and intercalated structures being observed also. Significant enhancements of the onset of decomposition were obtained by varying the strength of the interaction between the nanoparticle and the polymer. Varying the amount of a specific nanoparticle also affected the decomposition temperatures. A slight catalytic effect of the nanoparticles on both the imidization and crosslinking reaction has been observed and will be presented. In addition, incorporation of the nanoparticles was found to increase the glass transition temperature and slightly broaden the breadth of this relaxation.
Author
*Polyimides; Nanocomposites; Space Commercialization*

**20020019072** Rockwell Scientific Co., LLC, Thousand Oaks, CA USA
**Interphase Debonding in High Temperature Ceramic Composites** ***Final Report, 15 Jun. 1996-14 Jun 1999***
Marshall, David B.; Davis, Janek B.; Sep. 13, 2001; 136p; In English; Original contains color images
Contract(s)/Grant(s): F49620-96-C-0026
Report No.(s): AD-A396955; AFRL-SR-BL-TR-01-0534; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
Studies aimed at understanding the role of the interphase in providing a nonlinear response in oxide composites are described. Debonding and sliding of single crystal and eutectic oxide fibers coated with La-monazite caused intense plastic deformation of the LaPO4 at room temperature. Such plastic deformation mechanisms could be critical for preventing the development of very high stresses during constrained sliding of rough interfaces. A new class of machinable two-phase ceramics based on the debonding and deformation characteristics of rare-earth phosphates was demonstrated. Multilayered composites, consisting of various zirconia-based materials alternating with layers of LaPO4, were fabricated for studies of compatibility and debonding mechanisms.
DTIC
*Ceramic Matrix Composites; Debonding (Materials)*

**20020020653** Feng Chia Univ., Dept. of Materials Science, Taichung, Taiwan, Province of China
**Characterization of Iron Nitride Powders Formed by Mechanical Alloying and Atmospheric Heat Treatment Techniques**
Lin, Chung-Kwei, Feng Chia Univ., Taiwan, Province of China; Chen, Giin-Shan, Feng Chia Univ., Taiwan, Province of China; Chen, Jium-Shyong, Chung Shan Inst. of Science and Technology, Taiwan, Province of China; Chin, Tsung-Shune, National Tsing Hua Univ., Taiwan, Province of China; Lee, Pee-Yew, National Taiwan Ocean Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; November 2001; ISSN 0253-3839; Volume 24, No. 6, pp. 753-760; In English
Contract(s)/Grant(s): NSC-83-0405-E-019-002; Copyright; Avail: Issuing Activity
Iron nitrides were manufactured by mechanical alloying of Fe2.33N and Fe powder mixtures at starting compositions of Fe12N2 and Fe16N2 and annealed in air at 200 and 240 C. It was found that the supersaturated nanocrystal line alpha-Fe solid solution phase was produced after MA, and iron nitrides were formed after heat treatment. The saturation magnetization (sigma) of the heat-treated powders is higher than those of the as-milled powders. The sigma values for the specimens heat treated at 200 C are higher than those heat treated at 240 C, and the highest value among all of the samples is 218 e.m.u./g which is obtained by annealing of as-milled Fe12N2 powders in air at 200 C for 6 hours. The possible existence of the alpha-Fe16N2 phase is responsible for the high saturation magnetization in mechanically alloyed Fe16N2 and Fe12N2 powders.
Author
*Alloying; Heat Treatment; Iron Compounds; Metal Nitrides; Nanocrystals; Powder (Particles); Magnetization*

**20020020992** Saint Louis Univ., MO USA

**Investigation of Thermal Processing on the Properties of PS304: A Solid Lubricant Coating, *15 Jun. 2000 - 14 Jun. 2001***

Benoy, Patricia A., Saint Louis Univ., USA; [2002]; 6p; In English

Contract(s)/Grant(s): NAG3-2469; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The effect of thermal processing on PS304, a solid lubricant coating, was investigated. PS304 is a plasma sprayed solid lubricant consisting of 10% Ag and 10% BaF2 and CaF2 in a eutectic mixture for low and high temperature lubricity respectively. In addition, PS304 contains 20% Cr2O3 for increased hardness and 60% NiCr which acts as a binder. All percents are in terms of weight not volume. Previous research on thermal processing (NAG3-2245) of PS304 revealed that substrate affected both the pre- and post-anneal hardness of the plasma spray coating. The objective of this grant was to both quantify this effect and determine whether the root cause was an artifact of the substrate or an actual difference in hardness due to interaction between the substrate and the coating. In addition to clarifying past research developments new data was sought in terms of coating growth due to annealing.

Derived from text

*Annealing; Sprayed Coatings; Hardness*

**20020021282** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden

**IR: Properties of Some Binders for the Coatings Industry**

Lee, H. S.; Staaf, O.; Ghaemi, H.; Aug. 2000; ISSN 1104-9154; 50p; In English

Report No.(s): PB2002-100598; FOA-R-00-01576-615-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this study was to examine the thermal IR-properties of different polymeric binders employing FT-IR spectroscopy. From spectrometric data the band emittance in the two TIR-windows 3-5 and 8-12 micrometer to the minus 1 power was calculated. The band emittance is related to film thickness and by a curve fit procedure the band absorption coefficient alpha for each examined polymer was calculated, one in the 3-5 micrometers to the minus 1 power band and the other in the 8-12 micrometers to the minus 1 power band. These band absorption coefficients are the figure of merit when ranking the different polymers for use as binders in a thermal IR camouflage coating. Investigated polymers were polyurethanes, vinyl polymers, silicone polymers, epoxy resins, a chlorinated polyolefine polymer and polyethylene. The alpha values ranged from 0.0020 to 0.011 micrometers in the minus 1 power in the 3-5 micrometers to the minus 1 power and from 0.021 to 0.17 micrometers to the minus 1 power in the 8-12 micrometers to the minus 1 power spectral windows, i.e. the absorption coefficient alpha is about a factor ten higher for the 8-12 micrometers to the minus 1 power band compared to the 3-5 micrometer to the minus 1 power band. It also appears that a borderline can be drawn at alpha=0.015 micrometers to the minus 1 power separating the 3-5 micrometers to the minus 1 power band with low absorption properties from the 8-12 micrometers to the minus 1 power band with high absorption properties.

NTIS

*Binders (Materials); Coating; Fourier Transformation; Industries; Infrared Spectroscopy; Vinyl Polymers*

**20020021286** Southwest Texas State Univ., Dept. of Chemistry, San Marcos, TX USA

**Low Dielectric Polymers, *Period ending 31 Aug. 2001***

Cassidy, Patrick E., Southwest Texas State Univ., USA; [2002]; 6p; In English

Contract(s)/Grant(s): NCC1-376; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This report summarizes results obtained through our current research effort entitled 'Low Dielectric Polymers'. Results are reported in four areas: (1) Development of an alkyne containing a crosslinking agent for 12F-PEK and its analogues; (2) Preparation and evaluation of new silicon- and/or fluorine-containing polymers for low temperature applications; (3) Polymers derived from a new highly fluorinated monomer; and (4) Continued evaluation of the scale-up of the preparation of 6FC11- and 6FC17-PEKs.

Author

*Alkynes; Dielectrics; Monomers*

## 28
## PROPELLANTS AND FUELS

*Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.*

**20020016152** Defence Science and Technology Organisation, Fishermans Bend, Australia
**AMRL Evaluation of the JP-8+100 Jet Fuel Thermal Stability Additive**
Rawson, Paul; Apr. 2001; 27p; In English; Original contains color images
Report No.(s): AD-A396761; DSTO-TR-1135; DODA-AR-011-841; X5-X5; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An additive package designed to improve thermal stability of jet fuel by 1000 F (38 C), known as the JP8+100 additive, or more commonly as the USAF-developed JP8+1OO thermal stability additive, was evaluated to investigate its efficacy in reduction of thermal deposits formed in aircraft fuel systems. The additive was claimed to reduce deposits generated on fuel-wetted metal surfaces by up to 90%. An AED-designed rig capable of quantitatively evaluating jet fuel thermal stability was used to investigate jet fuels produced by different Australian refineries with various fuel finishing processes. The additive's effect on deposit formation from these fuels was investigated over a range of temperatures and fuel flow conditions giving both total deposit formation data and profiles of carbon and sulphur deposition on heat stressed, fuel-wetted steel tubing. This fuel additive is to be introduced into kAAF aircraft fuel systems that may have substantial levels of existing thermal deposit. An important consideration was thus the additive's ability to clean dirty fuel-wetted surfaces and the possibility of 'clumps' of deposit being washed into the fuel system. Levels of filterable deposit washed from a pre-deposited test section were monitored and the deposit levels were found to fall below levels generated in non-additised fuel. The +100 additive was found to substantially reduce the levels of carbonaceous deposit formed on hot metal fuel-wetted surfaces and performed as claimed in its ability to clean pre-deposited fuel wetted metal surfaces.
DTIC
*Thermal Stability; Jet Engine Fuels; Aircraft Fuel Systems; Clean Fuels; Fuel Flow*

**20020016157** Southwest Research Inst., Belvoir Fuels and Lubricants Research Facility, San Antonio, TX USA
**Investigation of Subterranean Fuel Vapor Extraction and Destruction Using a Diesel Engine** ***Interim Report, Oct. 2000-May 2001***
Stoecklein, Karl E.; Yost, Douglas M.; May 2001; 37p; In English
Contract(s)/Grant(s): DAAE07-99-C-L053
Report No.(s): AD-A396723; TFLRF-359; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this project was to determine the feasibility of using a diesel engine as a means of fuel vapor extraction and destruction at underground contamination sites. The first priority was to determine if fuel vapors introduced into the engine via the intake air stream could be burned satisfactorily. An engine operated in this manner functions similar to a dual-fuel natural gas/diesel unit, using liquid fuel as a pilot to ignite the gas-air mixture. A major concern with this concept is the possibility that fuel vapors pre-mixed with the intake air may be prone to detonation in a high compression diesel engine, therefore causing destructive knock. Another concern is whether the engine will run properly without using an excessive amount of supplemental liquid fuel, which then reduces the vapor extraction capability and overall efficiency of the system. Therefore, the main focus of this initial test phase was on combustion performance and pilot fuel requirements versus gaseous fuel consumption.
DTIC
*Extraction; Fuels; Vapors; Diesel Engines; Contamination*

**20020016206** Federal Energy Technology Center, Morgantown, WV USA
**Development of Technologies and Analytical Capabilities for Vision-21 Energy Plants**
Syamlal, M.; Apr. 20, 2001; 15p; In English
Report No.(s): DE2001-783112; FC26-00NT40954-02; No Copyright; Avail: Department of Energy Information Bridge

The project management plan was finalized during a project kickoff meeting held on January 16, 2001 in Lebanon, NH, which was attended by all project participants. The project management plan was submitted to the Department of Energy (DOE) and was revised based on comments from DOE. A survey of the potential users of the integrated software was conducted. A web-based survey form was developed and was announced in the ProcessCity discussion forum and in AspenTech's e-mail digest Aspen e-Flash. Several Fluent clients were individually contacted. A user requirements document was written. As a prototype of AspenPlus-Fluent integration, the flowsheet for allyl alcohol production via the isomerization of propylene oxide was developed.

A stirred tank reactor in the flowsheet for converting the byproduct acetone into n-propyl propionate was modeled with Fluent, version 5.4. The convergence of the AspenPlus-Fluent integrated model was demonstrated, and a list of data exchanges required between AspenPlus and Fluent was developed. As the first demonstration case, the RP and L power plant was selected. A planning meeting was held on February 13, 2001 in Cambridge, MA to discuss this demonstration case. It was decided that the steam-side of the power plant would be modeled with AspenPlus and the gas-side, with the ALSTOM Power in-house code INDVU. A flowsheet model of the power plant was developed. Three positive responses were received for the invitation to join the project Advisory Board. It was decided to expand the membership on the Advisory Board to include other industrial users interested in integrating AspenPlus and Fluent. Additional invitations were sent out. Integraph's role in the project was restructured based on discussions among the project participants. Fluent hired Dr. Maxwell Osawe to work on the project. Dr. Osawe brings to the project a unique combination of skills (expertise in CFD and object-oriented design and programming) required for the software integration task.
NTIS
*Project Management; Prototypes; Computer Programs*

**20020016207** Federal Energy Technology Center, Morgantown, WV USA
**Technology Development for Iron and Cobalt Fischer-Tropsch Catalysts**
Davis, B. H.; Oct. 01, 2000; 125p; In English
Report No.(s): DE2001-783107; FC26-98FT40308-08; No Copyright; Avail: Department of Energy Information Bridge

The use of alkali promoters has been widely practiced. However, data to compare various promoters is limited for the iron-based catalysts and much of the available data were obtained at low pressure or under a variety of reaction conditions. The importance of the alkali promoter in determining catalytic activity, stability, and selectivity merits a comparison of the promoters under suitable reaction conditions. The present study utilizes medium pressure synthesis conditions to compare the alkali promoters under the same reaction conditions and over a wide range of conversion levels. Iron-based Fischer-Tropsch (FT) catalysts undergo a series of phase transformations during activation and use. Activation with carbon monoxide or syngas typically results in the conversion of Fe2O3 to Fe3O4 and ultimately to one or more carbides. During FT synthesis, iron carbides can be oxidized to Fe3O4 if the H2O/H2 or CO2/CO ratios are high enough. There has been considerable debate about the active phase of the FT synthesis. Some studies have indicated an active oxide species while most have supported a carbide species. Moessbauer spectroscopy has proven to be an effective technique for the analysis of iron-based FT catalysts. In situ Moessbauer studies have been reported; however, these studies have been performed at low pressure and low conversions. Studies performed at industrially relevant conditions have generally involved removing the catalyst from the reactor followed by passivation which, if not performed properly, will oxidize the catalyst. Herein are reported the Moessbauer results obtained on an unpromoted precipitated iron catalyst that was activated and reacted in a slurry phase, continuous stirred tank reactor at high conversion and under industrially relevant conditions.
NTIS
*Alkalies; Carbides; Catalysts; Fischer-Tropsch Process; Iron Oxides*

**20020016250** Department of Energy, Aiken, SC USA
**Hydrogen Storage Development for Utility Vehicles**
Heung, L. K.; Jul. 18, 2001; 8p; In English
Report No.(s): DE2001-783584; WSRC-MS-2001-00025; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Hydrogen storage for mobile applications is still a challenge. Savannah River Technology Center (SRTC) and its partners have identified industrial utility vehicles and mining vehicles as potential early niche markets for the use of metal hydride to store hydrogen. The weight of metal hydride is not a problem for these vehicles. The low pressure of metal hydride gives a safety advantage. SRTC has developed onboard hydrogen storage containers using metal hydrides for the demonstration of two generations of fuel cell powered utility vehicles. Another storage container is being developed for a mining vehicle. This paper provides a brief overview of the utility vehicle project and a detail discussion of the hydrogen storage system.
NTIS
*Fuel Cells; Hydrogen; Metal Hydrides; Storage*

**20020016269** Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA

**High-Strain Rate Uniaxial Compression of Future Combat Systems (FCS) generation One High-Energy Gun Propellants** ***Final Report, May-Jul. 2001***

Leadore, Michael G.; Sep. 2001; 37p; In English; Original contains color images

Report No.(s): AD-A396603; ARL-TR-2571; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Six lots of Thiokol-manufactured Future Combat Systems (FCS) Generation One experimental high-energy gun propellants were tested in uniaxial compression. The materials were taken to over 60% strain at a strain rate of 100 per second, while conditioned at 21 C, 63 C, and -32 C. The stress at yield, strain at yield, Young's modulus, failure modulus, incremental energy density, and fracture assessment values were recorded for each test. The average values achieved are reported.

DTIC

*Fracture Mechanics; Gun Propellants; Tanks (Combat Vehicles)*

**20020016309** Joint Warfare Analysis Center, Dahlgren, VA USA

**Simulating the Composite Propellant Manufacturing Process**

Williamson, Suzanne, Joint Warfare Analysis Center, USA; Love, Gregory, Project Performance Corp., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 179-188; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

There is a strategic interest in understanding how the propellant manufacturing process contributes to military capabilities outside the United States. The paper will discuss how system dynamics (SD) has been applied to rapidly assess the capabilities and vulnerabilities of a specific composite propellant production complex. These facilities produce a commonly used solid propellant with military applications. The authors will explain how an SD model can be configured to match a specific production facility followed by a series of scenarios designed to analyze operational vulnerabilities. by using the simulation model to rapidly analyze operational risks, the analyst gains a better understanding of production complexities. There are several benefits of developing SD models to simulate chemical production. SD is an effective tool for characterizing complex problems, especially the production process where the cascading effect of outages quickly taxes common understanding. by programming expert knowledge into an SD application, these tools are transformed into a knowledge management resource that facilitates rapid learning without requiring years of experience in production operations. It also permits the analyst to rapidly respond to crisis situations and other time-sensitive missions. Most importantly, the quantitative understanding gained from applying the SD model lends itself to strategic analysis and planning.

Author

*Manufacturing; Military Technology; Composite Propellants; Computerized Simulation; Management Planning; Systems Engineering*

**20020016310** New Jersey Commission on Science and Technology, Newark, DE USA

**High Energy Density Powders of the Al-Mg Mechanical Alloys**

Dreizin, E. L., New Jersey Commission on Science and Technology, USA; Shoshin, Y. L., New Jersey Commission on Science and Technology, USA; Mudryy, R. S., New Jersey Commission on Science and Technology, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 189-199; In English; Also announced as 20020016300

Contract(s)/Grant(s): N00014-00-1-0446; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Metals such as Al, B, Mg, etc., have high combustion enthalpies and are considered as prospective energetic materials for propellants, explosives, and pyrotechnics. Currently, aluminum is most widely used in the high energy density formulations, however, long ignition delays and slow combustion kinetics limit the range of its applications. Recent research showed that internal phase changes occur and affect significantly the ignition and combustion processes of metal particles. It is suggested here that new metal-based materials can be designed in which pre-determined phase changes would occur and trigger ignition at a desired temperature and also accelerate the rate of heat release during combustion. to demonstrate the feasibility of this concept, metastable solid solutions of Mg in Al (10 - 50% of Mg) have been produced using mechanical alloying. The size distribution and phase compositions of the new powders were characterized using optical microscopy and x-ray diffraction, respectively. The oxidation enthalpies of the mechanical alloy powders were compared with those of the respective Al-Mg powder blends using oxygen bomb calorimetry. It was observed that the overall oxidation enthalpy did not change as a result of the mechanical alloying. The ignition temperatures of the produced alloys in air and water environments were determined using image processing of the digital video recordings of the electrically heated filaments coated with the alloy powders. Combustion of mechanical alloys in air was studied using a new aerosol burner producing steady, laminar, lifted flames of metal powders. The alloy powders ignition temperatures varied in the ranges of 950 - 1060 K and 930 - 1020 K in air and water, respectively-, in both cases much lower that the pure aluminum ignition temperature dose to 2300 K. Steady flames of mechanical alloy powders were produced at lower

equivalence ratios and had higher propagation velocities than similar pure aluminum powder flames. The flame structure suggested that the alloy particles bum primarily heterogeneously as opposed to the aluminum and magnesium particles that bum in the vapor phase. It was also observed that the alloy particles ignite with a bright flash similar to the radiation jumps observed to occur close to the end of combustion for many pure metal particles. The time of particle combustion was evaluated using flame size and propagation velocity. It was found that the ratio of the particle combustion time to the particle size square for alloy particles is two to three times lower than the similar ratio for aluminum particles. Phase compositions of the combustion products were determined using X-ray diffraction. In addition to Al2O3 and MgO, significant amounts of Al2MgO4 were found in experiments. Author

*Aluminum Alloys; Magnesium Alloys; Reaction Kinetics; Powdered Aluminum; Combustion Physics; Aluminum Oxides*

**20020016313** Naval Air Warfare Center, Research Dept., China Lake, CA USA

**Effect of Particle Size, Crystal Phase, and Temperature on the Partial Decomposition of Ammonium Perchlorate**

Kraeutle, K. J., Naval Air Warfare Center, USA; Atwood, A. I., Naval Air Warfare Center, USA; Curran, P. O., Naval Air Warfare Center, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 239-252; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The decomposition of ammonium perchlorate (AP) has been studied under isothermal conditions in argon at atmospheric pressure by measuring the loss of weight as function of time. For orthorhombic: AP, the weight loss data were obtained for three size fractions at six different temperatures and analyzed by the AVRAMI-EROFEYEV method which gave the best fit for n=2. The kinetic parameters for the induction period and decomposition proper were obtained and found to depend on particle size. For cubic AP, the weight loss of four size fractions was measured as function of time at 246 C. Comparable fits of weight loss data were obtained by use of the monomolecular law and the contracting volume method. The paper summarizes the results for orthorhombic AP that were presented at the 37th Combustion Subcommittee Meeting (Ref. 1). The results obtained to date for cubic AP are shown and discussed. They indicate consider-able changes in the decomposition behavior upon transition from orthorhombic to cubic AP.

Author

*Ammonium Perchlorates; Crystals; Decomposition; Temperature Effects; Particle Size Distribution; Weight (Mass)*

**20020016314** Pennsylvania State Univ., Dept. of Mechanical and Nuclear Engineering, University Park, PA USA

**Effect of Processing Procedures on Solid Propellant Burning Rate**

Young, G., Pennsylvania State Univ., USA; Boyer, E., Pennsylvania State Univ., USA; Risha, G. A., Pennsylvania State Univ., USA; Kuo, K. K., Pennsylvania State Univ., USA; Naylor, R., Allegany Ballistics Lab., USA; Snurr, G., Allegany Ballistics Lab., USA; Geiger, P., Allegany Ballistics Lab., USA; Kline, G., Allegany Ballistics Lab., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 253-261; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

A collaborative research study was performed in order to examine the effect of different processing procedures and oxidizer particle size distribution on the burn rate of the composite-modified double base propellant used in the Line of Sight Anti Tank missile. A family of cross-linked double-base propellant formulations containing HMX was processed at Alliant Techsystems' Allegany Ballistics Laboratory, then tested at the Pennsylvania State University. to obtain burn rate, a series of tests was performed over a range of pressures from 500 to 5000 psig (3.45 to 34.5 MPa) in a high-pressure windowed strand burner. An inhibitor was applied to the test samples since the propellant strands were found to be susceptible to flame spreading down the sides. Burn rates and slopes were also evaluated using 2 x 4-in (5 x 10 cm), 1-lb (0.45 kg) motors having 0.5-in (1.2 cm) webs and 1-in (2.5 cm) cylindrical bores. The 2 x 4 motor data demonstrated that the change of the rate of pressurization seemed to occur at the pressure corresponding to the slope break point of the strand burning rate correlation. The propellant was found to have bum rate and slope break location critically dependent upon particle size distribution and maximum size of the oxidizer particle. Propellants produced with ground, but nonprescreened HMX (with large particles on the order of 200 um after grinding) showed undesirable propellant burning behavior with unacceptably low slope break locations. HMX with an unground particle size cutoff at approximately 300 micrometers after prescreening yielded acceptable grinds with 60-micrometer particle size cutoff. Propellant produced from this material recovered acceptable ballistic properties. Production of the composite-modified double base propellant was successfully scaled up to a 150-gallon (568 L) mixer from much smaller prototype mixes. Mechanical and ballistic properties of samples from large mixes were found in agreement with the database from subscale mixes.

Author

*Ballistics; Burning Rate; Missiles; Double Base Rocket Propellants; Prototypes*

**20020016316** Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA

**Computational Modeling of Gel Bi-Propellant Combustion in the Vortex Engine**

Nusca, Michael J., Army Research Lab., USA; Michaels, R. Scott, Army Aviation and Missile Command, USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 275-285; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Army is developing new gelled bipropellants and tactical missile propulsion systems that utilize these propellants for both current and future combat systems. The use of hypergolic gel propellants introduces new challenges in combustion control. A major challenge is mixing the oxidizer and fuel to obtain maximum performance from the combustor without increasing the size of the engine. The impinging stream vortex engine, ISVE, offers an alternative to increasing the volume of the combustion chambers and has already generated excellent performance test data. Since the ISVE is a new concept, data and analytical models relating performance to engine design parameters are nonexistent. In order to fully exploit the performance advantages that have been realized for the ISVE, it is desirable to understand the underlying flow physics of the engine. This paper describes the first effort to use modem computational fluid dynamics, combined with high-performance computers to reveal gas dynamics and combustion patterns as well as predict chamber pressure and thrust levels in the ISVE.

Author

*Combustion Control; Computational Fluid Dynamics; Engine Design; Mathematical Models; Vortices; Gelled Rocket Propellants; Combustion Chambers*

**20020016317** Pennsylvania State Univ., Dept. of Mechanical and Nuclear Engineering, University Park, PA USA

**Characterization of Combustion and Propulsive Behavior of NF2-Based Solid Propellants**

Young, Gregory, Pennsylvania State Univ., USA; Kuo, Kenneth K., Pennsylvania State Univ., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 287-303; In English; Also announced as 20020016300

Contract(s)/Grant(s): N00014-99-1-0426; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

In an effort to increase the performance of solid rocket propellants, new and novel energetic propellant formulations were synthesized and tested. These new propellants were characterized experimentally in order to determine a number of important ballistic parameters. These parameters include the burning rate characteristics, temperature sensitivity, the Arrhenius form of burning rate law, and the stability behavior in terms of the Novozhilov parameters. The samples were tested in an optical strand burner through a broad range of pressures (50 less than P less than 3,000 psig) and initial temperatures (-25 less than T less than 50 C). The burning rate characteristics were determined through the use of break-wires. Propellant burning surface temperatures were determined from the subsurface temperature measurements made using fine-wire thermocouples. From these measurements, the ballistic parameters mentioned above were deduced. In addition to the ballistic parameters obtained from strand tests, an instrumented rocket motor was designed and fabricated in order to determine the propulsive behavior of these new propellants. The parameters of interest in these experiments included specific impulse (Isp), and C* efficiency. The rocket motor was equipped with two high-frequency pressure transducers, an ultrasonic transducer for measuring propellant grain regression rate, a piezoelectric load cell for measuring thrust, and a real-time X-ray radiography system for measuring both instantaneous propellant regression rate and instantaneous exit nozzle throat diameter. A number of system checkout tests were successfully conducted, which demonstrated that the motor was fully operational. Furthermore, several motor tests were conducted with the new energetic propellants, results of these tests are discussed in the paper.

Author

*Solid Rocket Propellants; Combustion Physics; Propulsive Efficiency; Nitrogen Compounds; Rocket Engines; Radiography*

**20020016319** Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA

**Evaluation of Current Thermochemical Equilibrium Analysis Codes: Availability, Capabilities, and Limitations**

Rohrbaugh, Eric M., Johns Hopkins Univ., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 321-335; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Thermochemical equilibrium analysis codes, used for the calculation of propellant performance characteristics, have been under development for the past 50 years. A number of these codes exist in the community today, the majority of which are improvements or modifications of two heritage codes: the commonly known NASA-Lewis code (today called Computer Equilibrium with Applications, or CEA); and the Naval Air Warfare Center (NAWC) Propellant Evaluation Program (PEP). Among the many derivatives are the Thermochemical Equilibrium Program (TEP), Propellant Evaluation Program (PEP), Graphical User Interface Propellant Evaluation Program (GUIPEP), and the Propellant Evaluation Program (PROPEP). The modifications and heritage codes are compared to evaluate their ease of use, availability, reliability, usefulness, limitations, cost, and legacy. Some of these programs are available at no cost. Some are released in two different versions (public and limited release

versions). Several of the codes are operated as a command line program, some use a graphical user interface (GUI), and yet others use an input deck. This evaluation illustrates the categories into which each of the different programs belong.
Author
*Thermochemistry; Gun Propellants; Applications Programs (Computers); Chemical Equilibrium*

**20020016320** Lawrence Livermore National Lab., Livermore, CA USA
**Pressure Wave Measurements from Thermal Cook-off of an HMX Based Explosive**
Forbes, J. W., Lawrence Livermore National Lab., USA; Tarver, C. M., Lawrence Livermore National Lab., USA; Urtiew, P. A., Lawrence Livermore National Lab., USA; Garcia, F., Lawrence Livermore National Lab., USA; Greenwood, D. W., Lawrence Livermore National Lab., USA; Vandersall, K. S., Lawrence Livermore National Lab., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 337-345; In English; Also announced as 20020016300
Contract(s)/Grant(s): W-7405-eng-48; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

A better understanding of thermal cook-off is important for safe handling and storing explosive devices. A number of safety issues exist about what occurs when a cased explosive thermally cooks off. For example, violence of the events as a function of confinement is important for predictions of collateral damage. This paper demonstrates how adjacent materials can be gauged to measure the resulting pressure wave and how this wave propagates in this adjacent material. The output pulse from the thermal cook-off explosive containing fixture is of obvious interest for assessing many scenarios.
Author
*HMX; Elastic Waves; Firing (Igniting); Explosives; Thermal Analysis*

**20020016321** Naval Air Warfare Center, Research Dept., China Lake, CA USA
**Experiments for Cookoff Model Validation**
Atwood, A. I., Naval Air Warfare Center, USA; Curran, P. O., Naval Air Warfare Center, USA; Decker, M. W., Naval Air Warfare Center, USA; Boggs, T. L., Naval Air Warfare Center, USA; Erickson, W. W., Sandia National Labs., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 347-362; In English; Propulsion Systems Hazards Meeting, Nov. 2000, USA; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Data for six cookoff tests using the explosive PBXN-109 are presented in this paper. The experiments were designed and performed as part of a joint DOD/DOE cookoff model validation effort. The tests were performed to provide experimental data that could be used to validate current cookoff models that are under development. The effect of void space, confinement and heating rate on the cookoff behavior of the explosive were investigated.
Author
*Firing (Igniting); Explosives; Mathematical Models; Temperature Measurement*

**20020016322** Lawrence Livermore National Lab., Livermore, CA USA
**Cookoff Response of PBXN-109: Material Characterization and ALE3D Thermal Predictions**
McClelland, M. A., Lawrence Livermore National Lab., USA; Tran, T. D., Lawrence Livermore National Lab., USA; Cunningham, B. J., Lawrence Livermore National Lab., USA; Weese, R. K., Lawrence Livermore National Lab., USA; Maienschein, J. L., Lawrence Livermore National Lab., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 363-380; In English; Also announced as 20020016300
Contract(s)/Grant(s): W-7405-eng-48; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Materials properties measurements are made for the RDX-based explosive, PBXN-109, and initial ALE3D model predictions are given for the cookoff temperature in a U.S. Navy test. This work is part of an effort in the U.S. Navy and Department of Energy (DOE) laboratories to understand the thermal explosion behavior of this material. Benchmark cookoff experiments are being performed by the U.S. Navy to validate DOE materials models and computer codes. The ALE3D computer code can model the coupled thermal, mechanical, and chemical behavior of heating, ignition, and explosion in cookoff tests. In our application, a standard three-step step model is selected for the chemical kinetics. The strength behavior of the solid constituents is represented by a Steinberg-Guinan model while polynomial and gamma-law expressions are used for the Equation Of State (EOS) for the solid and gas species, respectively. Materials characterization measurements are given for thermal expansion, heat capacity, shear modulus, bulk modulus, and One-Dimensional-Time-to-Explosion (ODTX). These measurements and those of the other project participants are used to determine parameters in the ALE3D chemical, mechanical, and thermal models. Time-dependent, two-dimensional results are given for the temperature and material expansion. The results show predicted cookoff temperatures slightly higher than the measured values.
Author
*Firing (Igniting); Reaction Kinetics; Thermodynamic Properties; Explosives; Mechanical Properties; Mathematical Models; RDX*

**20020016323** Safety Management Services, Inc., West Jordan, UT USA
**Classifying and Characterizing In-Process Energetic Material Using Laboratory and Small-Scale Standardized Tests**
Speed, T. C., Safety Management Services, Inc., USA; Ford, R. T., Safety Management Services, Inc., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 381-396; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

An approach is presented to classify and characterize energetic-bulk materials in manufacturing and/or demilitarization applications. This approach assists government and commercial manufacturers with proper facility design and siting of modified or new facilities. Understanding the characteristics of the in-process material ensures that proper safety requirements are addressed early in the designing and planning stages of a process. Established classification approaches for shipping and storage do not adequately address all of the issues associated with in-process operations and handling. However, standardized tests are available which allow for characterization of hazardous materials in operating scenarios.
Author
*Classifications; Manufacturing; Thermal Stability; Explosives; Thermal Analysis*

**20020016324** Intertox, Inc., Seattle, WA USA
**Development of a Reference Dose for Perchlorate: Current Issues and Status**
Pleus, R. C., Intertox, Inc., USA; Goodman, G., Intertox, Inc., USA; Mattie, D. R., Air Force Research Lab., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 397-405; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

The perchlorate anion (ClO4-) is typically manufactured as the ammonium salt. The most common use of ammonium perchlorate is in the aerospace program as a component of solid rocket fuel. The perchlorate anion is exceedingly stable under environmental conditions and has been found in ground and surface waters in CA, NV, LIT, AZ, TX, AK, NY, MD, VW and FL. The National Center for Environmental Assessment (NCEA) of the U.S. Environmental Protection Agency (US EPA) is in the process of developing an oral reference dose (RfD) for perchlorate. An oral RfD, is a body-weight-adjusted dose that can be consumed daily over an entire lifetime with the expectation of no adverse health effects. Once developed, the new RfD will be used by US EPA as the basis of a safe-drinking-water level (SDWL) guideline. US EPA and regional regulatory agencies will then jointly or separately propose clean-up action levels for ground and surface waters at contaminated sites. The toxicological database on ClO4(-) as of March 1997 was determined by an expert peer-review panel to be inadequate for the purpose of deriving an oral RfD. For example, little or no experimental data existed on the subchronic, reproductive, or developmental toxicity of perchlorate. to fill gaps in the toxicological database, eight animal studies were designed by a government-industry consortium that included US EPA and AFRL. These studies were performed in 1997-1998. It has been known for many years that in the thyroid, high doses of perchlorate block the function of iodide by competing for iodide binding sites. Perchlorate was used in the 1950s-60s as a treatment for Graves' disease (a hyperthyroid condition). Because of what was already known about the pharmacological mode of action of perchlorate, specific concerns addressed in the design of the recent animal studies included the potential for developmental toxicity, notably neurological development. Upon review of complete study reports from four of the studies and incomplete data from the other two, US EPA/NCEA issued a document in December 1998 stating that the critical effects were hormone and histology data from the neurodevelopmental/behavioral toxicity study that had been performed in rats; an RfD was proposed based upon the observation of thyroid-follicular-cell hypertrophy in the 5-day-old pups (PND) of dams

given perchlorate in drinking water at 0.1 mg/kg-day (the lowest dose tested) in this study. US EPA/NCEA also focused attention on a nonsignificant increase in motor activity observed in 14-day-old male pups in the same study at the same dose. In February 1999, a public workshop was convened at which an external peer-review panel determined that there was still insufficient data to support the development of a RfD. Additional studies were recommended. Since that time a clinical study revealed significant depression of thyroidal uptake of iodide in volunteers receiving potassium perchlorate at 10 mg/day for 14 days. Follow-up studies currently underway include a pathology working-group review of histology slides from the all of the previous studies, a motor activity study similar to the first behavioral study, an additional immunotoxicity study, male and female rat kinetic studies, a hormone interlaboratory study, and an effects study for thyroid and brain in developing rats. These studies are expected to be complete by mid-2000. A clinical study is planned to determine inhibition of iodide uptake and kinetic parameters in humans following 14-day perchlorate ingestion. The kinetics studies will provide data for developing physiologically based pharmacokinetic (PBPK) models for rats and humans needed to establish the RfD.
Author
*Ammonium Perchlorates; Dosage; Pharmacology; Neurology; Environment Protection; Toxicology*

**20020016357** Sandia National Labs., Albuquerque, NM USA
**Autonomous Optical Sensor System for the Monitoring of Nitrogen Dioxide from Aging Rocket Propellant**
Cox, T. D.; Singh, S.; Hunter, J. A.; Jones, G. D.; Sinclair, M. B.; Sep. 01, 2001; 21p; In English
Report No.(s): DE2001-787637; SAND2001-2953; No Copyright; Avail: Department of Energy Information Bridge

An optical sensor system has been developed for the autonomous monitoring of NO2 evolution in energetic material aging studies. The system is minimally invasive, requiring only the presence of a small sensor film within the aging chamber. The sensor material is a perylene/PMMA film that is excited by a blue LED light source and the fluorescence detected with a CCD spectrometer. Detection of NO2 gas is done remotely through the glass window of the aging chamber. Irreversible reaction of NO2 with perylene, producing the non-fluorescent nitroperylene, provides the optical sensing scheme. The rate of fluorescence intensity loss over time can be modeled using a numerical solution to the coupled diffusion and a nonlinear chemical reaction problem to evaluate NO2 concentration levels. The light source, spectrometer, spectral acquisition, and data processing were controlled through a Labview program run by a laptop PC. Due to the long times involved with materials aging studies the system was designed to turn on, warm up, acquire data, power itself off, then recycle at a specific time interval. This allowed the monitoring of aging HE material over the period of several weeks with minimal power consumption and stable LED light output. Despite inherent problems with gas leakage of the aging chamber they were able to test the sensor system in the field under an accelerated aging study of rocket propellant. They found that the propellant evolved NO2 at a rate that yielded a concentration of between 10 and 100 ppm. The sensor system further revealed that the propellant, over an aging period of 25 days, evolves NO2 with cyclic behavior between active and dormant periods.
NTIS
*Aging (Materials); Nitrogen Dioxide; Optical Measuring Instruments; Rocket Propellants*

**20020016400** Federal Energy Technology Center, Morgantown, WV USA
**Proof of principal test to feed and meter granular coal into 450 psig gas pressure**
Aldred, D. L.; Jul. 01, 2000; 36p; In English
Report No.(s): DE2001-784619; FG26-98FT40330-06; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This research program is concerned with the development of a new form of feeder, known as the Stamet Posimetric O High Pressure Solids Feeder, to feed dry granular solids continuously and controllably into gas pressure. The device is a rotary mechanical feeder, which utilizes the interlocking and internal friction of the granular solids to drive the solids through into the outlet pressure in a continuous and controllable way, using a continuous solids material seal on the feeder outlet to control gas leakage. Earlier work sponsored under previous SBIR grants has successfully demonstrated the potential benefits of the Stamet machine over pressurized lock hopper or paste feeder methods. The objective of this project was to demonstrate proof of principal to feed and meter specified granular coal into 450 psig gas pressure for use with next generation pressurized fluidized bed combustors. This report encompasses the development of material transport properties testers, methods to predict feeder performance by calculation, and the modification and testing of Stamet feeders to feed the material supplied into pressure. Testers were made to measure material compressibility, bulk density, both internal and wall friction coefficients, and permeability under typical conditions experienced inside a Stamet high pressure feeder. This data is then used in support of ongoing efforts to develop calculations to predict the performance of Stamet pressure feeders with different materials and conditions. Three Stamet pressure feeders were modified to handle the fine granular or pulverized coal, and were tested under various conditions using different outlet arrangements. The initial testing identified difficulties in handling the fine materials, but through a series of calculations

and tests, the issues were overcome and the material was successfully fed into pressure. In all cases the performance calculated based on the measured material properties and feeder geometry agreed well with the test results, confirming the ability to predict performance and select geometry required to handle different conditions. However, the maximum pressure achieved was limited by an ineffective auger design, which was unable to effectively control the length of the outlet seal at higher pressures without imposing additional mechanical loads on the surface of the coal seal. This prevented steady state conditions being maintained long enough to reach the target pressure. Though the specified coal was successfully pumped into pressures over 200 psi, and the test results clearly indicate the changes required to provide a fixed outlet geometry that would achieve the 450 psi target, time and funding was not available to pursue this goal further under this project.
NTIS
*Coal; Combustion Chambers; Gas Pressure; Feeders*

**20020016428** Federal Energy Technology Center, Morgantown, WV USA
**Promoted zinc chromite catalysts for higher alcohol synthesis**
Sun, X.; Roberts, G. W.; Dec. 20, 2000; 21p; In English
Report No.(s): DE2001-783704; FG26-97FT97262-07; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

During this reporting period, a 'zinc chromite' catalyst promoted with 6 wt.% cesium (Cs) was evaluated at the following operating conditions: Temperature - 375 C and 400 C; Total Pressure--13.6 MPa (2000 psig); Gas Hourly Space Velocity (GHSV) - 5000 standard liters/kg(cat)-hr; and H(sub 2)/CO feed ratio--0.5, 1.0 and 2.0 mole/mole. Decahydronaphthalene (DHN) was used as the slurry liquid. The experiment lasted for twelve days of continuous operation. Unpromoted zinc chromite catalyst then was re-examined under the same operating conditions. Reproducible data was achieved with a continuous liquid make-up. Compared with unpromoted zinc chromite catalyst, 6 wt.% Cs-promoted catalyst shifted the product distribution from methanol to higher alcohols, even though methanol was still the major product. The effect of operating conditions was less important than the addition of promoter. However, it was observed that higher temperature favors higher alcohol synthesis, and that a higher H(sub 2)/CO ratio leads to lower oxygenates selectivity and higher hydrocarbons selectivity. These trends showed clearly with the Cs-promoted catalyst, but were not as prominent with the unpromoted catalyst. The slurry liquid did not decompose or alkylate to a measurable extent during either continuous, 12 - day experiment, even with the higher reactor temperature (400 C). There was a relatively significant loss of catalyst surface area during the experiment with the promoted catalyst, but not with the unpromoted catalyst.
NTIS
*Alcohols; Zinc; Catalysts; Chromites*

**20020016429** Federal Energy Technology Center, Morgantown, WV USA
**Aqueous biphase extraction for processing of fine coal**
Osseo-Asare, K.; Zeng, X.; Jun. 30, 2001; 18p; In English
Report No.(s): DE2001-783703; FG22-96PC96211-09; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ever-stringent environmental constraints dictate that future coal cleaning technologies be compatible with micron-size particles. This research program seeks to develop an advanced coal cleaning technology uniquely suited to micron-size particles, i.e., aqueous biphase extraction. The partitioning behaviors of silica in the polyethylene glycol (PEG)/dextran (Dex) and dextran/Triton X-100 (TX100) systems have been investigated, and the effects of sodium dodecylsulfate (SDS) and dodecyltrimethylammonium bromide (DTAB) on solid partition have been studied. In both biphase systems, silica particles stayed in the top PEG-rich phase at low pH. With increase in pH, the particles moved from the top phase to the interface, then to the bottom phase. At very high pH, the solids preferred the top phase again. These trends are attributable to variations in the polymer/solid and nonionic surfactant/solid interactions. Addition of ionic surfactants into these two systems introduces a weakly charged environment, since ionic surfactants concentrate into one phase, either the top phase or the bottom phase. Therefore, coulombic forces also play a key role in the partition of silica particles because electrostatic attractive or repulsive forces are produced between the solid surface and the ionic-surfactant-concentrated phase. For the PEG/dextran system in the presence of SDS, SiO(sub 2) preferred the bottom dextran-rich phase above its pH(sub PZC). However, addition of DTAB moved the oxide particles from the top phase to the interface, and then to the bottom phase, with increase in pH. These different behaviors are attributable to the fact that SDS and DTAB concentrated into the opposite phase of the PEG/dextran system. On the other hand, in the dextran/Triton X-100 system, both ionic surfactants concentrated in the top surfactant-rich phase and formed mixed micelles with TX100. Therefore, addition of the anionic surfactant, SDS, moved the silica particles from top phase to the interface or bottom

phase. On the other hand, DTAB, a cationic surfactant, attracted the particles to the top phase in the pH range form 4 to 11, where in the DTAB-free system the solids either stayed at the interface or in the bottom phase.
NTIS
*Coal; Extraction; Cleaning; Microparticles*

**20020016430** Federal Energy Technology Center, Morgantown, WV USA
**Aqueous biphase extraction for processing of fine coal**
Osseo-Asare, K.; Zeng, X.; Jun. 30, 2001; 15p; In English
Report No.(s): DE2001-783702; FG22-96PC96211-08; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ever-stringent environmental constraints dictate that future coal cleaning technologies be compatible with micron-size particles. This research program seeks to develop an advanced coal cleaning technology uniquely suited to micron-size particles, i.e., aqueous biphase extraction. The partitioning behaviors of hematite in the dextran (Dex)/Triton X-100 (TX100) and polyethylene glycol (PEG)/dextran systems were investigated and the effects of some ionic surfactants on solid partition were studied. In both biphase systems, the particles stayed in the bottom dextran-rich phase under all pH conditions. This behavior is attributable to the fact that the hydrophilic oxide particles prefer the more hydrophilic bottom phase. Also, the strong favorable interaction between dextran and ferric oxide facilitates the dispersion of the solids in the polysaccharide-rich phase. In the Dex/TX100 system, addition of sodium dodecylsulfate (SDS) or potassium oleate had no effect on the solid partition; on the other hand, addition of dodecyltrimethylammonium bromide (DTAB) transferred the particles to the top phase or interface at high pH values. In the PEG/Dex system, the preferred location of hematite remained the bottom phase in the presence of either SDS or DTAB. The effects of anionic surfactants on the partition behavior are attributable to the fact that they are not able to replace the strongly adsorbed polysaccharide layer on the ferric oxide surface. The results with the cationic surfactant are due to electrostatic interaction between the cationic surfactant and the charged surface of the solid particles. The difference in solids partitioning in the two systems is the result of the different distribution of DTAB in these systems. In the Dex/TX100 system, DTAB prefers the top surfactant-rich phase, while it concentrates in the bottom phase in the PEG/dextran system.
NTIS
*Coal; Extraction; Microparticles; Cleaning*

**20020016446** National Renewable Energy Lab., Golden, CO USA
**Fabrication and Testing of a Prototype Ceramic Furnace Coil for Chemical and Petrochemical Processing: Inventions and Innovation Industrial Materials for the Future Project Fact Sheet**
Jan. 25, 2001; 2p; In English
Report No.(s): DE2001-783549; DOE/GO-102001-1039; NREL/FS-810-28265; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Project fact sheet written for the Inventions and Innovation Program about a new process to produce ethylene more efficiently.
NTIS
*Fabrication; Furnaces; Performance Tests; Ceramics*

**20020016481** Analytic Power Corp., Boston, MA USA
**Hydrogen Supply System for Small PEM Fuel Cell Stacks** ***Final Report, Oct. 1996-1997***
Staples, L.; Bloomfield, D. P.; July 1997; 29p; In English
Report No.(s): AD-A396778; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This program was to determine how to employ thermolysis of chemical hydrides to produce low cost hydrogen for Soldier Power System (SPS) type fuel cells. Originally, the program was directed at the Digital Reactor concept. Early in the program, we determined that the digital reactor could not be made safe, light weight, or at low cost. We attempted to find an alternative to the digital reactor which, while still employing Beckert Dengel thermoloysis chemistry, could be made safe, light weight, and inexpensive. We failed in that attempt as well. This report documents the fundamental problems to be overcome in developing a chemical hydride based hydrogen generator.
DTIC
*Gas Generators; Fuel Cells; Hydrogen; Hydrides*

**20020016669** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Flash kinetics in liquefied noble gases: Studies of alkane activation and ligand dynamics at rhodium carbonyl centers, and a search for xenon-carbene adducts**

Yeston, J. S.; Jul. 26, 2001; 141p; In English

Report No.(s): DE2001-785323; LBNL-48643; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Results are presented from a low temperature infrared (IR) flash kinetic study of C-H bond activation via photoinduced reaction of CpRh(CO)2 (1) with linear and cyclic alkanes in liquid krypton and liquid xenon solution. No reaction was observed with methane; for all other hydrocarbons studied, the rate law supports fragmentation of the overall reaction into an alkane binding step followed by an oxidative addition step. For the binding step, larger alkanes within each series (linear and cyclic) interact more strongly than smaller alkanes with the Rh center. The second step, oxidative addition of the C-H bond across Rh, exhibits very little variance in the series of linear alkanes, while in the cyclic series the rate decreases with increasing alkane size.

NTIS

*Kinetics; Alkanes; Carbonyl Compounds; Infrared Radiation; Liquefied Gases*

**20020016967** NASA Marshall Space Flight Center, Huntsville, AL USA

**Space Resource Requirements for Future In-Space Propellant Production Depots**

Smitherman, David, NASA Marshall Space Flight Center, USA; Fikes, John, NASA Marshall Space Flight Center, USA; Roy, Stephanie, Futron Corp., USA; Henley, Mark W., Boeing Co., USA; Potter, Seth D., Boeing Co., USA; [2001]; 12p; In English; Space Resources Utilization Roundtable III, 24-26 Oct. 2001, Golden, CO, USA

Contract(s)/Grant(s): RTOP 905-22-00; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In 2000 and 2001 studies were conducted at the NASA Marshall Space Flight Center on the technical requirements and commercial potential for propellant production depots in low Earth orbit (LEO) to support future commercial, NASA, and other Agency missions. Results indicate that propellant production depots appear to be technically feasible given continued technology development, and there is a substantial growing market that depots could support. Systems studies showed that the most expensive part of transferring payloads to geosynchronous orbit (GEO) is the fuel. A cryogenic propellant production and storage depot stationed in LEO could lower the cost of missions to GEO and beyond. Propellant production separates water into hydrogen and oxygen through electrolysis. This process utilizes large amounts of power, therefore a depot derived from advanced space solar power technology was defined. Results indicate that in the coming decades there could be a significant demand for water-based propellants from Earth, moon, or asteroid resources if in-space transfer vehicles (upper stages) transitioned to reusable systems using water based propellants. This type of strategic planning move could create a substantial commercial market for space resources development, and ultimately lead toward significant commercial infrastructure development within the Earth-Moon system.

Derived from text

*Low Earth Orbits; Propellant Storage; Geosynchronous Orbits*

**20020017461** Army Research Lab., Aberdeen Proving Ground, MD USA

**High-Rate Mechanical Response of BAMO/GAP/RDX High-Energy Gun Propellant** ***Final Report, Sep.-Dec. 2000***

Leadore, Michael G.; Sep. 2001; 36p; In English; Original contains color images

Contract(s)/Grant(s): Proj-1L161102AH43

Report No.(s): AD-A396814; ARL-TR-2597; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One lot of BAMO/GAP/RDX (3,3-bisAZIDOMETHYL oxetane/glycidyl azide polymer/ cyclotrimethylenetrinatramine) next-generation gun propellant was tested in uniaxial compression at strain rates of 100(exp s-1) The material was conditioned at temperatures of 21 deg, 50 deg, and -20 deg C. End strain of the tested material was ^60%. The stress at failure, strain at failure, compressive modulus, failure modulus, incremental energy density, and the fracture assessment values were recorded for each test.

DTIC

*Mechanical Properties; Explosives; Gun Propellants; RDX; Glycidyl Azide Polymer; Axial Strain*

**20020017475** Federal Energy Technology Center, Morgantown, WV USA

**Field demonstration of a membrane process to recover heavy hydrocarbons and to remove water from natural gas**

Baker, R.; Hofmann, T.; Kaschemekat, J.; Lokhandwala, K. A.; Jan. 11, 2001; 7p; In English

Report No.(s): DE2001-784600; FC26-99FT40723-02; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of this project is to design, construct and field demonstrate a 3-MMscfd membrane system to recover natural gas liquids (NGL) and remove water from raw natural gas. An extended field test to demonstrate system performance under real-world conditions is required to convince industry users of the efficiency and reliability of the process. The system will be designed and fabricated by Membrane Technology and Research, Inc. (MTR) and then installed and operated at British Petroleum (BP)-Amoco's Pascagoula, MS plant. The Gas Research Institute will partially support the field demonstration and BP-Amoco will help install the unit and provide onsite operators and utilities. The gas processed by the membrane system will meet pipeline specifications for dewpoint and Btu value and can be delivered without further treatment to the pipeline. Based on data from prior membrane module tests, the process is likely to be significantly less expensive than glycol dehydration followed by propane refrigeration, the principal competitive technology. At the end of this demonstration project the process will be ready for commercialization. The route to commercialization will be developed during this project and may involve collaboration with other companies already servicing the natural gas processing industry.
NTIS
*Hydrocarbons; Membranes; Natural Gas*

**20020017538** National Petroleum Technology Office, Tulsa, OK USA
**Effective Continuum Model for the Liquid-to-Gas Phase Change in a Porous Medium Driven by Solute Diffusion, 2, Constant Liquid Withdrawal Rates**
Tsimpanogiannis, I. N.; Yortsos, Y. C.; Aug. 15, 2001; 35p; In English
Report No.(s): DE2001-784396; DOE/BC/15211-16; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes the development of an effective continuum model to describe the nucleation and subsequent growth of a gas phase from a supersaturated, slightly compressible binary liquid in a porous medium, driven by solute diffusion.This report also focuses on the processes resulting from the withdrawal of the liquid at a constant rate. As before, the model addresses two stages before the onset of bulk gas flow, nucleation and gas phase growth. Because of negligible gradients due to gravity or viscous forces, the critical gas saturation, is only a function of the nucleation fraction.
NTIS
*Continuum Modeling; Diffusion; Nucleation; Solutes; Vapor Phases*

**20020017539** National Petroleum Technology Office, Tulsa, OK USA
**Effective Continuum Model for the Liquid-to-Gas Phase Change in a Porous Medium Driven by Solute Diffusion, 1, Constant Pressure Decline Rates**
Tsimpanogiannis, I. N.; Yortsos, Y. C.; Aug. 15, 2001; 49p; In English
Report No.(s): DE2001-784395; DOE/BC/15211-15; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report, focuses on the isothermal gas phase growth from a supersaturated, slightly compressible, binary liquid in a porous medium. This is driven by mass transfer, the extent of which is controlled by the application of either a constant-rate decline of the system pressure or the withdrawal of the liquid at a constant rate. This report deals with the first process. Pressure depletion due to constant-rate liquid withdrawal is analyzed in a companion report.
NTIS
*Continuum Modeling; Diffusion; Mass Transfer; Solutes*

**20020017748** NASA Marshall Space Flight Center, Huntsville, AL USA
**Cryogenic Propellant Long-Term Storage With Zero Boil-Off**
Hedayat, Ali, Sverdrup Technology, Inc., USA; Hastings, L. J., NASA Marshall Space Flight Center, USA; Bryant, C., NASA Marshall Space Flight Center, USA; Plachta, D. W., NASA Glenn Research Center, USA; [2001]; 5p; In English; Cryogenic Engineering Conference, 16-20 Jul. 2001, Madison, WI, Madison, WI, USA, USA
Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Significant boil-off losses from cryogenic propellant storage systems in long-duration space mission applications result in additional propellant and larger tanks. The potential propellant mass loss reductions with the Zero Boil-off (ZBO) concept are substantial; therefore, further exploration through technology programs has been initiated within NASA. A large-scale demonstration of the ZBO concept has been devised utilizing the Marshall Space Flight Center (MSFC) Multipurpose Hydrogen Test Bed (MHTB) along with a cryo-cooler unit. The ZBO concept consists of an active cryo-cooling system integrated with traditional passive thermal insulation. The cryo-cooler is interfaced with the MHTB and spraybar recirculation/mixer system in a manner that enables thermal energy removal at a rate that equals the total tank heat leak. The liquid hydrogen (LH2) is withdrawn

from the tank, passed through a heat exchanger, and then the chilled liquid is sprayed back into the tank through a spraybar. The test series will be performed over a 20-30 day period. Tests will be conducted at multiple fill levels to demonstrate concept viability and to provide benchmark data to be used in analytical model development. In this paper the test set-up and test procedures are presented.
Author
*Cryogenics; Propellant Storage; Propellant Tanks; Heat Exchangers; Leakage*

**20020018127** Federal Energy Technology Center, Morgantown, WV USA
**Barrier Issues to the Utilization of Biomass**
Weber, G. F.; Zygarlicke, C. J.; May 01, 2001; 26p; In English
Report No.(s): DE2001-785189; FC26-00NT41014-01; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Well over half of the electric generation in the USA is derived from coal. Many electric utilities which use coal for power generation are considering the use of renewable fuels such as waste products or energy crop-derived biomass fuels as a potential economic option for reducing greenhouse gas emissions. Calculations by the National Renewable Energy Laboratory show that cofiring 15% and 5% by heat input of urban waste biomass with Illinois No. 6 coal reduces greenhouse gas emissions by 22% and 7%, respectively, on a CO2-equivalent basis per unit of electricity produced. Therefore, biomass cofiring in coal-fired plants has the potential to significantly reduce greenhouse gas emissions. Questions arise as to the availability of biomass resources, modifications that may be necessary for existing plants, and the global greenhouse gas inventory. Therefore, the greatest potential for the utilization of biomass exists for smaller boilers used for heating and generation of process steam represented by older stoker-fired units and newer fluid-bed combustion units.
NTIS
*Biomass; Greenhouse Effect; Electric Generators*

**20020018128** Federal Energy Technology Center, Morgantown, WV USA
**Conceptual Design Assessment for the Co-Firing of Bio-Refinery Supplied Lignin Project**
Berglund, T.; Ranney, J. T.; Babb, C. L.; Broder, J. G.; Jul. 01, 2001; 15p; In English
Report No.(s): DE2001-785152; FC26-99FT40670-05; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The major aspects of this project are proceeding toward completion. Prior to this quarter, design criteria, tentative site selection, facility layout, and preliminary facility cost estimates were completed and issued. Processing of bio-solids was completed, providing material for the pilot operations. Pilot facility design, equipment selection, and modification were completed during the fourth quarter of 2000. Initial pilot facility shakedown was completed during the fourth quarter. After some unavoidable delays, a suitable representative supply of MSW feed material was procured. During this first quarter of 2001, shredding of the feed material and final feed conditioning were completed. Pilot facility hydrolysis production was completed to produce lignin for co-fire testing. During this quarter, TVA completed the washing and dewatering of the lignin material produced from the MSW hydrolysis. Seven drums of lignin material were washed to recover the acid and sugar from the lignin and provide an improved fuel for steam generation. Samples of both the lignin and bio-solids fuel materials for co-fire testing were sent to the co-fire facility (EERC) for evaluation. After sample evaluation, EERC approved sending the material and all of the necessary fuel for testing was shipped to EERC. EERC has requested and will receive coal typical of the fuel to the TVA-Colbert boilers. This material will be used at EERC as baseline material and for mixing with the bio-fuel for combustion testing. EERC combustion testing of the bio based fuels is scheduled to begin in August of 2001.
NTIS
*Cost Estimates; Design Analysis; Lignin*

**20020018157** Aerospace Corp., Lab. Operations, El Segundo, CA USA
**Assessment of Perchlorate Releases in Launch Operations**
Lang, V. I.; Bohman, K. R.; Tooley, J. T.; Fournier, E. W.; Brady, B. B.; Oct. 25, 2001; 44p; In English; Original contains color images
Contract(s)/Grant(s): F04701-00-C-0009
Report No.(s): AD-A396842; TR-2001(1306)-3; SMC-TR-02-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An overall approach to the assessment of potential perchlorate (ClO4(-)) releases from launch operations is presented. Two particular aspects of the assessment have been addressed to date. Laboratory studies to determine the effects of salinity and temperature on the chemical kinetics of perchlorate release from solid rocket motor propellant were conducted. The results

showed an increase in the rate of perchlorate loss with increasing temperature and a decrease in the rate with increasing salinity. Second, a methodology developed for evaluating solid rocket motor propellant dispersal in the event of a catastrophic failure was applied to several failed historic launches as well as to Delta IV and Atlas V cases.
DTIC
*Perchlorates; Spacecraft Launching; Technology Assessment; Solid Propellant Rocket Engines; Delta 4 Launch Vehicle; Atlas Able 5 Launch Vehicle*

**20020018163** Thiokol Propulsion, Brigham City, UT USA
**General Overview of the ODC Elimination Effort of the RSRM Program**
Evans, Kurt, Thiokol Propulsion, USA; Golde, Rick, Thiokol Propulsion, USA; [2001]; 8p; In English; 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS8-38100
Report No.(s): AIAA Paper 2001-3859; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche
The purpose of the ODC Elimination Program of the Space Shuttle RSRM Program is to eliminate the usage of 1, 1, 1 trichloroethane (TCA) in all RSRM (Reusable Solid Rocket Motor) manufacturing processes. This program consists of the following phases and objectives: Phase 0 - Convert to greaseless shipping of metal components. Phase 1 - Eliminate TCA vapor degreasing and usage in propellant cleaning operations. Phase 2 - Eliminate TCA usage for hand cleaning operations. Each phase reduces peak TCA consumption (about 1.4 million pounds in 1989) by about 29, 61, and 10 percent, respectively. Phase 0 was completed in 1992, Phase 1 in 1997, and Phase 2 is in progress (about 75% complete). TCA replacement objectives are accomplished by are a series of subscale, full-scale, and static testing outlined by the NASA-funded, ODC Elimination Program.
Author
*Technology Assessment; Static Tests; Solid Propellant Rocket Engines; Replacing*

**20020018181** National Energy Technology Lab., Pittsburgh, PA USA
**Wabash river coal gasification repowering project**
Sep. 01, 2000; 358p; In English
Report No.(s): DE2001-787567; FC21-92MC29310-31; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The close of 1999 marked the completion of the Demonstration Period of the Wabash River Coal Gasification Repowering Project. This Final Report summarizes the engineering and construction phases and details the learning experiences from the first four years of commercial operation that made up the Demonstration Period under Department of Energy (DOE) Cooperative Agreement DE-FC21-92MC29310. This 262 MWe project is a joint venture of Global Energy Inc. (Global acquired Destec Energy's gasification assets from Dynegy in 1999) and PSI Energy, a part of Cinergy Corp. The Joint Venture was formed to participate in the Department of Energy's Clean Coal Technology (CCT) program and to demonstrate coal gasification repowering of an existing generating unit impacted by the Clean Air Act Amendments. The participants jointly developed, separately designed, constructed, own, and are now operating an integrated coal gasification combined-cycle power plant, using Global Energy's E-Gas(trademark) technology (E-Gas(trademark) is the name given to the former Destec technology developed by Dow, Destec, and Dynegy). The E-Gas(trademark) process is integrated with a new General Electric 7FA combustion turbine generator and a heat recovery steam generator in the repowering of a 1950's-vintage Westinghouse steam turbine generator using some pre-existing coal handling facilities, interconnections, and other auxiliaries. The gasification facility utilizes local high sulfur coals (up to 5.9% sulfur) and produces synthetic gas (syngas), sulfur and slag by-products. The Project has the distinction of being the largest single train coal gasification combined-cycle plant in the Western Hemisphere and is the cleanest coal-fired plant of any type in the world. The Project was the first of the CCT integrated gasification combined-cycle (IGCC) projects to achieve commercial operation.
NTIS
*Coal Gasification; Electric Power Plants*

**20020018183** National Energy Technology Lab., Pittsburgh, PA USA
**BENCH-SCALE DEMONSTRATION OF HOT-GAS DESULFURIZATION TECHNOLOGY**
Sep. 01, 2000; 19p; In English
Report No.(s): DE2001-787564; AC21-93MC30010--30; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The U.S. Department of Energy (DOE), National Energy Technology Laboratory (NETL), is sponsoring research in advanced methods for controlling contaminants in hot coal gasifier gas (coal-derived fuel-gas) streams of integrated gasification combined-cycle (IGCC) power systems. The hot gas cleanup work seeks to eliminate the need for expensive heat recovery equipment, reduce efficiency losses due to quenching, and minimize wastewater treatment costs. Hot-gas desulfurization research has focused on regenerable mixed-metal oxide sorbents that can reduce the sulfur in coal-derived fuel-gas to less than 20 ppmv and can be regenerated in a cyclic manner with air for multicycle operation. Zinc titanate (Zn(sub 2)TiO(sub 4) or ZnTiO(sub 3)), formed by a solid-state reaction of zinc oxide (ZnO) and titanium dioxide (TiO(sub 2)), is currently one of the leading sorbents. Overall chemical reactions with Zn(sub 2)TiO(sub 4) during the desulfurization (sulfidation)-regeneration cycle are shown. The sulfidation/regeneration cycle can be carried out in a fixed-bed, moving-bed, or fluidized-bed reactor configuration. The fluidized-bed reactor configuration is most attractive because of several potential advantages including faster kinetics and the ability to handle the highly exothermic regeneration to produce a regeneration offgas containing a constant concentration of SO(sub 2).
NTIS
*High Temperature Gases; Desulfurizing; Coal Derived Gases*

**20020018184** National Energy Technology Lab., Pittsburgh, PA USA
**Biomass reburning - modeling/engineering studies**
Zamansky, V.; Lindsey, C.; Lissianski, V.; Jan. 28, 2000; 49p; In English
Report No.(s): DE2001-787562; FC26-97FT97270--09; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This project is designed to develop engineering and modeling tools for a family of NO(sub x) control technologies utilizing biomass as a reburning fuel. During the ninth reporting period, EER (Energy and Environmental Research) prepared a paper Kinetic Model of Biomass Reburning and submitted it for publication and presentation at the 28th Symposium (International) on Combustion, University of Edinburgh, Scotland, July 30-August 4, 2000. Antares Group Inc, under contract to Niagara Mohawk Power Corporation, evaluated the economic feasibility of biomass reburning options for Dunkirk Station. A preliminary report is included in this quarterly report.
NTIS
*Biomass; Combustion; Biomass Energy Production*

**20020018185** National Energy Technology Lab., Pittsburgh, PA USA
**Removal of h2s and so2 by caco3-based sorbents at high pressures**
Sotirchos, S. V.; Sep. 01, 2000; 100p; In English
Report No.(s): DE2001-787561; FG22-95PC95217-06; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The mechanism of the removal of SO(sub 2) and H(sub 2)S by CaCO(sub 3)-based sorbents in pressurized fluidized-bed coal combustors (PFBC) and high pressure gasifiers was investigated in this project. Reactivity evolution experiments were carried out in thermogravimetric apparatuses both under simulated high pressure conditions and at high pressures. Experiments at high pressure were conducted in a high pressure thermogravimetric arrangement that was set up and developed under this project. Two calcitic solids of high calcium carbonate content (over 97%) were employed in the experiments: a fine-grained distributed by Greer Limestone Co. (Greer Limestone) and a solid supplied in the form of large calcitic crystals (Iceland Spar). The decision to work with these solids was mainly based on the fact that they have been employed in several past studies of sulfation, sulfidation, and calcination in our laboratory, and therefore, a large volume of data on their performance under different conditions was available for comparison purposes. In addition to the experimental studies, work was also done on the development of rigorous mathematical models for the description of the occurrence of simultaneous processes (e.g., calcination and sulfation and carbonation and sulfation) in the interior of porous solids and for the simulation of the evolution of the pore structure of porous solids that undergo chemical transformation in their interior.
NTIS
*Sorbents; Hydrogen Sulfide; Combustion Chambers; Coal*

**20020018512** National Energy Technology Lab., Pittsburgh, PA USA
**Bench-Scale Demonstration of Hot-Gas Desulfurization Technology**
Jul. 01, 1999; 18p; In English
Report No.(s): DE2001-787565; AC21-93MC30010-32; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The U.S. Department of Energy (DOE), National Energy Technology Laboratory (NETL), is sponsoring research in advanced methods for controlling contaminants in hot coal gasifier gas (coal-derived fuel-gas) streams of integrated gasification combined-cycle (IGCC) power systems. The hot gas cleanup work seeks to eliminate the need for expensive heat recovery equipment, reduce efficiency losses due to quenching, and minimize wastewater treatment costs. Hot-gas desulfurization research has focused on regenerable mixed-metal oxide sorbents that can reduce the sulfur in coal-derived fuel-gas to less than 20 ppmv and can be regenerated in a cyclic manner with air for multicycle operation. Zinc titanate (Zn(sub 2)TiO(sub 4) or ZnTiO(sub 3)), formed by a solid-state reaction of zinc oxide (ZnO) and titanium dioxide (TiO(sub 2)), is currently one of the leading sorbents. Overall chemical reactions with Zn(sub 2)TiO(sub 4) during the desulfurization (sulfidation)-regeneration cycle are shown. The sulfidation/regeneration cycle can be carried out in a fixed-bed, moving-bed, or fluidized-bed reactor configuration. The fluidized-bed reactor configuration is most attractive because of several potential advantages including faster kinetics and the ability to handle the highly exothermic regeneration to produce a regeneration off-gas containing a constant concentration of SO(sub 2).
NTIS
*Contaminants; High Temperature Gases; Desulfurizing; Coal Derived Gases; Electric Generators*

**20020018627** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Life Time Predictions of Propellants** ***Final Report***
Boers, M. N., Prins Maurits Lab. TNO, Netherlands; deKlerk, W. P. C., Prins Maurits Lab. TNO, Netherlands; Krabbendam-LaHaye, E. L. M., Prins Maurits Lab. TNO, Netherlands; July 2001; 48p; In English; Original contains color illustrations
Contract(s)/Grant(s): A98/KL/534; TNO Proj. 014.11270
Report No.(s): TD2001-A18; PML-2001-A-18; Copyright; Avail: Issuing Activity
An artificial aging program on a single base (DPA-stabilized) and a DEGDN (Akardit 2-stabilized) propellant is set up to compare three apparatus able to determine the safe lifetime of propellants, i.e., the heat flow calorimeter (HFC), the thermal activity monitor (TAM) and the high performance liquid chromatograph (HPLC). The HFC is not only used in its normal configuration but also with a small sample vessel which enables to measure safely at a higher filling degree, equal to the filling degree in the TAM, but up to the higher conversions as usual for the HFC. The results show that the small HFC vessels leads to results with the typical shape of the TAM results, in contrast to the normal vessels, that are more comparable to the HPLC STANAG 4117 with respect to volume and filling degree. It may depend on the munition article concerned whether the small or the normal vessel is representative. Furthermore a short introduction to the draft STANAG 4582 is presented.
Author
*Propellants; Life (Durability); Aging (Materials); Stability*

**20020018628** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Investigation of the Residue from Pyrotechnic Munitions** ***Final Report Onderzoek Verschoten Rook en Lichtmunitie***
vanHam, N. H. A., Prins Maurits Lab. TNO, Netherlands; Eerligh, R., Prins Maurits Lab. TNO, Netherlands; July 2001; 19p; In Dutch; Original contains color illustrations
Contract(s)/Grant(s): A00/KL/481; TNO Proj. 014.12666
Report No.(s): TD-2001-A35; PML-2001-A35; Copyright; Avail: Issuing Activity
Leftover smoke and light munitions contain large quantities of reaction products. The presence of these products makes it necessary to treat these leftovers as chemical waste.
Author
*Pyrotechnics; Hazardous Wastes; Smoke; Waste Management*

**20020018892** Clark-Atlanta Univ., GA USA
**Liquid Fuels: Pyrolytic Degradation and Fire Spread Behavior as Influenced by Buoyancy**
Yeboah, Yaw D., Clark-Atlanta Univ., USA; Malbrue, Courtney, Clark-Atlanta Univ., USA; Savage, Melane, Clark-Atlanta Univ., USA; Liao, Bo, Clark-Atlanta Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 19; In English; Also announced as 20020018881
Report No.(s): P11; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document
This work is being conducted by the Combustion and Emission Control Lab in the Engineering Department at Clark Atlanta University under NASA Grant No. NCC3-707. The work aims at providing data to supplement the ongoing NASA research activities on fire spread across liquid pools by providing flow visualization and velocity measurements especially in the gas phase and gas-liquid interface. The fabrication, installation, and testing were completed during this reporting period. The system

shakedown and detailed quantitative measurements with High Speed Video and Particle Image Velocimetry (PIV) systems using butanol as fuel were performed. New and interesting results, not previously reported in the literature, were obtained from the experiments using a modified NASA tray and butanol as fuel. Three distinct flame spread regimes, as previously reported, were observed. These were the pseudo-uniform regime below 20 C, the pulsating regime between 22 and 30 C and the uniform regime above about 31 C. In the pulsating regime the jump velocity appeared to be independent of the pool temperature. However, the retreat velocity between jumps appeared to depend on the initial pool temperature. The flame retreated before surging forwards with increasing brightness. Previous literature reported this phenomenon only under microgravity conditions. However, we observed such behavior in our normal gravity experiments. Mini-pulsations behind the flame front were also observed. Two or three of these pulsations were observed within a single flame front pulsating time period. The velocity vector maps of the gas and liquid phases ahead, during, and behind the flame front were characterized. At least one recirculation cell was observed right below the flame front.The size of the liquid phase vortex (recirculation cell) below the flame front appeared to decrease with increasing initial pool temperature. The experiments also showed how multiple vortices developed in the liquid phase. A large recirculation cell, which generally spins counterclockwise as the flame spread from right to left, was observed ahead of and near the flame front in the gas phase. Detailed quantitative measurements will be undertaken with the LDV and PIV systems using the modified NASA tray and propanol.

Author

*Liquid Fuels; Flame Propagation; Pyrolysis; Buoyancy*

**20020019075** Fraunhofer-Inst. fuer Chemische Technologie, Pfinztal, Germany

**Energetic Materials: Analysis, Diagnostics and Testing** ***Final Report, 27-30 Jun. 2000***

Jun. 27, 2000; ISSN 0722-4807; 1383p; In English; In German; 31st, 3-6 Jul. 2001, Karlsruhe, Germany

Report No.(s): AD-A396941; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

These are presentation and poster session papers presented at the 31st International Annual Conference of CT held in Karlsruhe, Germany, on June 27-30, 2000. In recent years the technical progress in synthesis, processing and application of energetic materials was positively influenced by advanced analytical methods, diagnostics and measuring techniques. Efficient screening methods, new sensoring techniques and combinatorial approaches are examples for analytical strategies making accurate data available and allowing their fast evaluation. The conference objectives include the investigation and characterization of energetic materials by analytical methods, the improvement of existing measuring techniques and the development of new analytical methods and strategies.

DTIC

*Explosives; Combinatorial Analysis; Diagnosis*

**20020019089** Prins Maurits Lab. TNO, Rijswijk, Netherlands

**Influence of Crystal Quality on the Sensitivity and Processability of PBXs** ***Final Report***

Bouma, R. H. B., Prins Maurits Lab. TNO, Netherlands; October 2001; 58p; In English; Original contains color illustrations

Contract(s)/Grant(s): A96/KL/483; TNO Proj. 014.12883

Report No.(s): TD2001-0061; PML-2001-A61; Copyright; Avail: Issuing Activity

Internal defects in RDX crystals, which can be visualized and quantified with light microscopy and liquid pycnometry, contribute to the shock sensitivity of Plastic Bonded eXplosives. The processability in casting as well as extrusion of energetic compositions with (almost) spherical particles, is directly related to the packing density of the RDX crystals, the desired amount of RDX in the final composition, and the viscosity of the not-yet cured binder system. The tendency of Plastic Bonded eXplosives to deteriorate under impact conditions is less when the size of the dispersed RDX particles becomes smaller.

Author

*Explosives; RDX; Sensitivity Analysis; Morphology; Mechanical Properties; Crystal Defects*

**20020020460** Southwest Research Inst., Tardec Fuels and Lubricants Research Facility, San Antonio, TX USA

**Investigation of Portable Oil Analysis Requirements for Army Application** ***Interim Report***

Marbach, H. W., Jr; Nov. 1999; 38p; In English

Contract(s)/Grant(s): DAAK70-92-C-0059

Report No.(s): AD-A397159; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objectives of this project were to define critical used oil properties and to investigate and analyze oil analysis methods that could be used at the unit level to provide a go/no-go result regarding oil condition and the equipment readiness.

Implementation of unit-level analysis could provide a reduction of samples sent to AOAP labs for full analysis thereby reducing costs.
DTIC
*Cost Reduction; Oils*

**20020020464** Southwest Research Inst., San Antonio, TX USA
**Evaluation of Impacts of JP-8+100 on Army Aviation and Ground Vehicles: Phase I Impact Study** ***Interim Report, Dec. 1998-Jan. 2000***
Moses, C. A.; Frame, E. A.; Alvarez, R. A.; Stoecklein, K. E.; Marbach, T. L.; Nov. 2000; 76p; In English; Original contains color images
Contract(s)/Grant(s): DAAK70-92-C-0059
Report No.(s): AD-A397145; SWRI-IR-TFLRF-353; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
As the Army has converted to the 'Single Fuel on the Battlefield Doctrine' and extensively uses JP-8 in all diesel-powered ground material systems, there are concerns about the acceptability of JP-8+100 for Army systems as the Air Force uses JP-8+100 in the future. The potential effects of JP-8+100 fuel on Army ground and aviation equipment were investigated to determine the scope of any expected problems and possible benefits from its use.
DTIC
*Diesel Engines; JP-8 Jet Fuel*

**20020020671** Argonne National Lab., IL USA
**Catalytic partial oxidation reforming of hydrocarbon fuels**
Ahmed, S.; Sep. 21, 1998; 7p; In English
Report No.(s): DE2001-10729; ANL/CMT/CP-96059; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The polymer electrolyte fuel cell (PEFC) is the primary candidate as the power source for light-duty transportation systems. On-board conversion of fuels (reforming) to supply the required hydrogen has the potential to provide the driving range that is typical of today's automobiles. Petroleum-derived fuels, gasoline or some distillate similar to it, are attractive because of their existing production, distribution, and retailing infrastructure. The fuel may be either petroleum-derived or other alternative fuels such as methanol, ethanol, natural gas, etc. The ability to use a variety of fuels is also attractive for stationary distributed power generation, such as in buildings, or for portable power in remote locations. Argonne National Laboratory has developed a catalytic reactor based on partial oxidation reforming that is suitable for use in light-duty vehicles powered by fuel cells. The reactor has shown the ability to convert a wide variety of fuels to a hydrogen-rich gas at less than 800 C, temperatures that are several hundreds of degrees lower than alternative noncatalytic processes. The fuel may be methanol, ethanol, natural gas, or petroleum-derived fuels that are blends of various hydrocarbons such as paraffins, olefins, aromatics, etc., as in gasoline. This paper will discuss the results obtained from a bench-scale (3-kWe) reactor, where the reforming of gasoline and natural gas generated a product gas that contained 38% and 42% hydrogen on a dry basis at the reformer exit, respectively.
NTIS
*Hydrocarbon Fuels; Oxidation; Electrolytic Cells*

## 29
## SPACE PROCESSING

*Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see 84 Law, Political Science and Space Policy.*

**20020017749** NASA Marshall Space Flight Center, Huntsville, AL USA
**Use of Traveling Magnetic Fields to Control Melt Convection**
Ramachandran, Narayanan, Universities Space Research Association, USA; Mazuruk, Konstantin, Universities Space Research Association, USA; Volz, Martin P., NASA Marshall Space Flight Center, USA; Journal of Japan Society of Microgravity Applications; [2000]; Volume 17, No. 2, pp. 98-103; In English
Contract(s)/Grant(s): NCC8-66; Copyright; Avail: Issuing Activity
An axially traveling magnetic wave induces a meridional base flow in an electrically conducting molten cylindrical zone. This flow can be beneficial for crystal growth applications. In particular, it can be effectively used to stir the melt in long cylindrical

columns. It can also be tailored to modify the thermal and species concentration fields in the melt and to control the interface shape of the growing crystal. The basic theory of such an application is developed and data from a preliminary mercury column experiment are presented.
Author
*Cylindrical Bodies; Magnetic Fields; Meridional Flow; Traveling Waves*

**20020019797** NASA Marshall Space Flight Center, Huntsville, AL USA
**ISS Microgravity Research Payload Training Methodology**
Schlagheck, Ronald, NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; AIAA ISS Utilization Conference, 15-17 Oct. 2001, Cape Canaveral, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The NASA Microgravity Research Discipline has multiple categories of science payloads that are being planned and currently under development to operate on various ISS on-orbit increments. The current program includes six subdisciplines; Materials Science, Fluids Physics, Combustion Science, Fundamental Physics, Cellular Biology and Macromolecular Biotechnology. All of these experiment payloads will require the astronaut various degrees of crew interaction and science observation. With the current programs planning to build various facility class science racks, the crew will need to be trained on basic core operations as well as science background. In addition, many disciplines will use the Express Rack and the Microgravity Science Glovebox (MSG) to utilize the accommodations provided by these facilities for smaller and less complex type hardware. The Microgravity disciplines will be responsible to have a training program designed to maximize the experiment and hardware throughput as well as being prepared for various contingencies both with anomalies as well as unexpected experiment observations. The crewmembers will need various levels of training from simple tasks as power on and activate to extensive training on hardware mode change out to observing the cell growth of various types of tissue cultures. Sample replacement will be required for furnaces and combustion type modules. The Fundamental Physics program will need crew EVA support to provide module change out of experiment. Training will take place various research centers and hardware development locations. It is expected that onboard training through various methods and video/digital technology as well as limited telecommunication interaction. Since hardware will be designed to operate from a few weeks to multiple research increments, flexibility must be planned in the training approach and procedure skills to optimize the output as well as the equipment maintainability. Early increment lessons learned will be addressed.
Author
*Microgravity; International Space Station; Payloads; Spaceborne Experiments; Biotechnology; Education*

**20020019839** NASA Marshall Space Flight Center, Huntsville, AL USA
**Crystal Growth of HgZnTe Alloy by Directional Solidification in Low Gravity Environment**
Su, Ching-Hua; Sha, Y. G.; Lehoczky, Sandor; Szofran, Frank; Gillies, Don; Scripa, Rose; Cobb, Sharon; Wang, J. C.; [2001]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

A Hg0.84Zn0.16Te alloy crystal was back-melted and partially resolidified during the first USA Microgravity Laboratory (USML-1) mission in the Marshall Space Flight Center's Crystal Growth Furnace. The experiment was inadvertently terminated at about 30% of planned completion. Nonetheless, it was successfully demonstrated that a HgZnTe alloy ingot partially grown and quenched on the ground can be back-melted and regrown in space under nearly steady state growth conditions. An identical "groundtruth" experiment was performed following the mission and a comparison between the properties of the crystals is described. The results indicate the importance of residual microgravity acceleration (approx. less than 0.4 mg) even in the sub-microgravity range for the slow solidification velocities and large density gradients.
Author
*Crystal Growth; Directional Solidification (Crystals); Microgravity; Mercury Tellurides; Zinc Tellurides*

## 31
## ENGINEERING (GENERAL)

*Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see categories 32 through 39.*

**20020016192** California Univ., Berkeley, CA USA
**Comparative guide to emerging diagnostic tools for large commercial HVAC systems**
Friedman, H.; Piette, M. A.; May 01, 2001; 96p; In English

Report No.(s): DE2001-787155; LBNL-48629; CD-435; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This guide compares emerging diagnostic software tools that aid detection and diagnosis of operational problems for large HVAC systems. We have evaluated six tools for use with energy management control system (EMCS) or other monitoring data. The diagnostic tools summarize relevant performance metrics, display plots for manual analysis, and perform automated diagnostic procedures. Our comparative analysis presents nine summary tables with supporting explanatory text and includes sample diagnostic screens for each tool.

NTIS

*Buildings; Computer Programs; Diagnosis; Emergencies; Cooling Systems*

**20020016212** Sandia National Labs., Albuquerque, NM USA

**Backward Integration of the Equations of Motion to Correct for Free Surface Perturbations**

Hayes,; May 01, 2001; 28p; In English

Report No.(s): DE2001-783087; SAND2001-1440; No Copyright; Avail: Department of Energy Information Bridge

Window and free surface interfaces perturb the flow in compression wave experiments. The velocity of these interfaces is routinely measured in shock-compression experiments using interferometry (i.e., VISAR). Interface perturbations often must be accounted for before meaningful material property results can be obtained. For shockless experiments when stress is a single valued function of strain, the governing equations of motion are hyperbolic and can be numerically integrated forward or backward in either time or space with assured stability. Using the VISAR results as 'initial conditions' the flow fields are integrated backward in space to the interior of the specimen where the VISAR interface has not perturbed the flow at earlier times and results can be interpreted as if the interface had not been present. This provides a rather exact correction for free surface perturbations. The method can also be applied to window interfaces by selecting the appropriate initial conditions. Applications include interpreting Z-accelerator ramp wave experiments. The method applies to multiple layers and multiple reverberations. For an elastic-plastic material model the flow is dissipative and the governing equations are parabolic. When the parabolic terms are small, the equations also can be successfully integrated backward in space. This is verified by using a traditional elastic-plastic wave propagation code with a backward-derived stress history as the boundary condition for a forward calculation. Calculated free surface histories match the starting VISAR record verifying that the backward method produced an accurate solution to the governing equations. With our cooperation, workers at Los Alamos have successfully applied the Sandia-developed backward technique for the time-dependent quasielastic material model and are analyzing stress histories at a spall plane using the VISAR free surface velocity measurement from a 'pullback' experiment.

NTIS

*Compression Waves; Equations of Motion; Flow Distribution; Interferometry; Perturbation; Wave Propagation*

**20020016223** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Technical and economic analysis of energy efficiency of Chinese room air conditioners**

Fridley, D. G.; Rosenquist, G.; Jiang, L.; Li, A.; Xin, D.; Feb. 01, 2001; 61p; In English

Report No.(s): DE2001-783454; LBNL-45550; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

China has experienced tremendous growth in the production and sales of room air conditioners over the last decade. Although minimum room air conditioner energy efficiency standards have been in effect since 1989, no efforts were made during most of the 1990's to update the standard to be more reflective of current market conditions. In 1999, China's State Bureau of Technical Supervision (SBTS) included in their annual plan the development and revision of the 1989 room air conditioner standard, and experts from SBTS worked together with LBNL to analyze the new standards. Based on the engineering and life cycle-cost analyses performed, the most predominant type of room air conditioner in the Chinese market (split-type with a cooling capacity between 2500 and 4500 W (8500 Btu/h and 15,300Btu/h)) can have its efficiency increased cost-effectively to an energy efficiency ratio (EER) of 2.92 W/W (9.9 Btu/hr/W). If an EER standard of 2.92 W/W became effective in 2001, Chinese consumers would be estimated to save over 3.5 billion Yuan (420 million U.S. dollars) over the period of 2001-2020. Carbon emissions over the same period would be reduced by approximately 12 million metric tons.

NTIS

*Economic Analysis; Technology Assessment; Air Conditioning Equipment; China*

**20020016230** National Renewable Energy Lab., Golden, CO USA

**Path to Zero Energy Homes**

Merrigan, T.; Mar. 30, 2001; 6p; In English

Report No.(s): DE2001-783415; DOE/GO-102001-1287; NREL/BR-550-29915; No Copyright; Avail: Department of Energy Information Bridge

Just imagine living in Florida and your fantasies might turn to swaying palms, fresh orange juice and lots of air-conditioning. For most people, a summer spent in Florida's heat and humidity would be unbearable without it. So air-conditioning is a necessity. But it's also a big energy drain, accounting for about 35% of all electricity used in a typical Florida house. As the largest single source of energy consumption in Florida, a home's air-conditioning load represents the biggest energy challenge. The Florida Solar Energy Center (FSEC) designed a project to answer this challenge. Two homes were built with the same floor plan on near-by lots. The difference was that one (the "control home") conformed to local residential building practices, and the other (the "Zero Energy home") was designed with energy efficiency in mind and solar technology systems on the roof. The homes were then monitored carefully for energy use. The project's designers were looking to answer two important questions: Could a home in a climate such as central Florida's be engineered and built so efficiently that a relatively small PV system would serve the majority of its cooling needs - and even some of its daytime electrical needs. And, would that home be as comfortable and appealing as the conventional model built alongside it. The answer to both questions turned out to be a resounding yes. and the test was especially rigorous, because it was conducted in the summer of 1998 - one of the hottest summers on record in Florida. This news is important for city planners, architects, builders, and homeowners not only in the Sunshine State, but elsewhere, too. The solar/energy efficiency combo worked so well in Florida that it can - and should - be tried in other parts of the country. This brochure describes the Zero Energy Homes concept using a case study.

NTIS

*Energy Conservation; Photovoltaic Conversion; Florida; Residential Energy*

**20020016452** National Renewable Energy Lab., Golden, CO USA

**Air Source Heat Pumps**

Krigger, J.; May 30, 2001; 8p; In English

Report No.(s): DE2001-783394; DOE/GO-102001-1113; FS143,NREL/BR-810-28037; No Copyright; Avail: Department of Energy Information Bridge

This fact sheet discusses how an air-source heat pump can heat and cool a home, as well how to select, install, operate, and maintain one.

NTIS

*Heat Pumps; Heating Equipment*

**20020016672** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Simulation of residential HVAC system performance**

Walker, I. S.; Siegel, J. A.; Degenetais, G.; May 01, 2001; 10p; In English

Report No.(s): DE2001-785278; LBNL-47622; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In many parts of North America residential HVAC systems are installed outside conditioned space. This leads to significant energy losses and poor occupant comfort due to conduction and air leakage losses from the air distribution ducts. In addition, cooling equipment performance is sensitive to air flow and refrigerant charge that have been found to be far from manufacturers specifications in most systems. The simulation techniques discussed in this paper were developed in an effort to provide guidance on the savings potentials and comfort gains that can be achieved by improving ducts (sealing air leaks) and equipment (correct air-flow and refrigerant charge). The simulations include the complex air flow and thermal interactions between duct systems, their surroundings and the conditioned space. They also include cooling equipment response to air flow and refrigerant charge effects. Another key aspect of the simulations is that they are dynamic-which accounts for cyclic losses from the HVAC system and the effect of cycle length on energy and comfort performance.

NTIS

*Space Heating (Buildings); Air Conditioning; Ventilation; Air Flow*

**20020016704** Brookhaven National Lab., Upton, NY USA

**Analysis of measurement uncertainties in the nulling test for air leakage from residential ducts**

Andrews,; Apr. 01, 2001; 30p; In English

Report No.(s): DE2001-783979; BNL-68430; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An analysis of measurement uncertainties in a recently proposed method of measuring air leakage in residential duct systems has been carried out. The uncertainties in supply and return leakage rates are expressed in terms of the value of the envelope leakage flow coefficient and the uncertainties in measured pressures and air flow rates. Results of the analysis are compared with data published by two research groups.
NTIS
*Air Ducts; Leakage*

**20020016713** NASA Marshall Space Flight Center, Huntsville, AL USA
**Preliminary Component Integration Using Rapid Prototyping Techniques**
Cooper, Ken, NASA Marshall Space Flight Center, USA; Salvail, Pat, IIT Research Inst., USA; [2001]; 7p; In English; 5th NASA Jet Propulsion Laboratory Engineering Workshop, 26-28 Jun. 2001, Pasadena, CA, USA; Sponsored by Jet Propulsion Lab., California Inst. of Tech., USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Rapid prototyping is a very important tool that should be used by both design and manufacturing disciplines during the development of elements for the aerospace industry. It helps prevent lack of adequate communication between design and manufacturing engineers (which could lead to costly errors) through mutual consideration of functional models generated from drawings. Rapid prototyping techniques are used to test hardware for design and material compatibility at Marshall Space Flight Center.
Author
*Manufacturing; Rapid Prototyping; Aerospace Engineering*

**20020016787** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Fouling of HVAC fin and tube heat exchangers**
Siegel, J.; Carey, V. P.; Jul. 01, 2001; 8p; In English
Report No.(s): DE2001-785280; LBNL-47668; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Fin and tube heat exchangers are used widely in residential, commercial and industrial HVAC applications. Invariably, indoor and outdoor air contaminants foul these heat exchangers. This fouling can cause decreased capacity and efficiency of the HVAC equipment as well as indoor air quality problems related to microbiological growth. This paper describes laboratory studies to investigate the mechanisms that cause fouling. The laboratory experiments involve subjecting a 4.7 fins/cm (12 fins/inch) fin and tube heat exchanger to an air stream that contains monodisperse particles. Air velocities ranging from 1.5-5.2 m/s (295 ft/min-1024 ft/min) and particle sizes from 1-8.6 microns are used. The measured fraction of particles that deposit as well as information about the location of the deposited material indicate that particles greater than about 1 micron contribute to fouling. These experimental results are used to validate a scaling analysis that describes the relative importance of several deposition mechanisms including impaction, Brownian diffusion, turbophoresis, thermophoresis, diffusiophoresis, and gravitational settling. The analysis is extended to apply to different fin spacings and particle sizes typical of those found in indoor air.
NTIS
*Heat Exchangers; Air Conditioning; Ventilation; Indoor Air Pollution*

**20020018626** Physics and Electronics Lab. TNO, The Hague, Netherlands
**Intrusion Detection, Generics and State-of-the-Art Technology *Final Report***
Luiijf, H. A. M., Physics and Electronics Lab. TNO, Netherlands; Coolen, R., Physics and Electronics Lab. TNO, Netherlands; July 2001; 92p; In English; Original contains color illustrations
Contract(s)/Grant(s): V.909; TNO Proj. 29466
Report No.(s): NAVO-RTO-TR-49; FEL-01-B162; Copyright; Avail: Issuing Activity

Internal and external threats to NATO Communication and Information Systems (CISs), amplified by interconnecting with CISs of other nations and organizations, increase the risk of intrusions or other irregularities. A prerequisite for effective counter-measures is early, and often real-time warnings about intrusions in NATO and interconnected coalition CISs. Intrusion Detection Systems (IDSs) are technical means that focus on the detection of intrusions in and to a CIS. This technical report introduces an IDS generic model, where IDSs consist of sensor, management and alarm-processing components and optionally may have reaction, deception, and visualisation components. To show how IDSs can be deployed and operate at different locations in a CIS, a generic model based on the CIS architecture is introduced. The state-of-the-art technical standards for interoperability of IDSs are discussed. Finally, the generic models are extended as a way to look at intrusion detection in a coalition environment.
Author
*Detection; Information Systems; Computer Information Security; Architecture (Computers)*

**20020018850** National Defence Research Establishment, Dept. of Weapons and Protection, Stockholm, Sweden
**Visit to Department of Engineering Science in Oxford and Cavendish Laboratory at Cambridge University** ***Studiebesoeka pa Department of Engineering Science i Oxford och pa Cavendish Laboratory i Cambridge***
Oskarsson, M.; Jacob, M.; Nilsson, M.; Petersson, J.; Pettersson, A.; Oct. 2000; 24p; In Swedish
Report No.(s): PB2001-107731; FOA-R-00-0-17-45-310-SE; No Copyright; Avail: National Technical Information Service (NTIS)

This travel report describes some interesting details observed during the visit at the Department of Engineering Science in Oxford and the Cavendish Laboratory in Cambridge. The visit at these two laboratories was part of a competence program in the field of dynamic material behavior.
NTIS
*Engineering; Laboratories; Universities*

**20020020647** NASA Marshall Space Flight Center, Huntsville, AL USA
**Use of Capillaries for Macromolecular Crystallization in a Cryogenic Dewar**
Ciszak, Ewa, NASA Marshall Space Flight Center, USA; Hammons, Aaron S., Universities Space Research Association, USA; Hong, Young Soo, Universities Space Research Association, USA; [2001]; 2p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

The Enhanced Gaseous Nitrogen (EGN) Dewar is a cryogenic dry shipper with a sealed cylinder inserted inside along with a temperature-monitoring device, and is intended for macromolecular crystallization experiments on the International Space Station. Within the Dewar, each crystallization experiment is contained as a solution within a plastic capillary. The standard procedure for loading samples in these tubes has involved rapid freezing of the precipitant and biomolecule solution directly in liquid nitrogen; this method, however, often results in uncontrolled formation of air voids. These air pockets, or bubbles, then can lead to irreproducible crystallization results. A novel protocol has been developed to prevent formation of bubbles, and this has been tested in the laboratory as well as aboard the International Space Station during a 42-day long mission of July/August of 2001. Furthermore, gain or loss of mass from solutions within the capillaries revealed that mass transport amongst separated tubes occurred, and that this mass transport was determined by the hygroscopic character of a solution contained in any given tube. The sample volume and the surface area of the plastic capillary tube also related to the observed mass transport.
Author
*Crystallization; Cryogenic Equipment; Liquid Nitrogen; Capillary Tubes*

## 32
## COMMUNICATIONS AND RADAR

*Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 Space Communications, Spacecraft Communications, Command and Tracking; for search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation and Safety.*

**20020016282** Sandia National Labs., Albuquerque, NM USA
**Routing Data Authentication in Wireless Ad Hoc Networks**
Torgerson, M. D.; VanLeeuwen, B. P.; Oct. 01, 2001; 15p; In English
Report No.(s): DE2001-787792; SAND2001-3119; No Copyright; Avail: Department of Energy Information Bridge

In this paper, we discuss several specific threats directed at the routing data of an ad hoc network. We address security issues that arise from wrapping authentication mechanisms around ad hoc routing data. We show that this bolt-on approach to security may make certain attacks more difficult, but still leaves the network routing data vulnerable. We also show that under a certain adversarial model, most existing routing protocols cannot be secured with the aid of digital signatures.
NTIS
*Computer Information Security; Security; Protocol (Computers)*

**20020016342** kk Consulting, Ottobrunn, Germany
**German Air Force Procedures for Implementing Interoperable Information Systems in C(sup 2), Weapon, and Support Systems to Support NATO Led Combined Joint Task Force Operations**
Kulke, Klaus, kk Consulting, Germany; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 15-1 - 15-3; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

This paper summarizes the German Armed Forces conclusions and activities to establish operational interoperability on future tactical data link networks with forces of other nations. It describes the steps taken by national authorities to meet this challenging goal and it describes the currently achieved status. The key conclusion is a strict application of interoperability management procedures to develop appropriate platform documents, first on a conceptual level and then, on a specification level with the subsequent implementation of interoperable platform Information Systems based on a Task Force-centric and Link Network-centric approach. The approach does consider the NATO (North Atlantic Treaty Organization) Combined Joint Task Force (CJTF) Concept and the 'New ways to do Business' as outlined in the new joint command and control philosophy within the NATO military command structure.
Author
*Data Links; Information Systems; Interoperability; International Cooperation; Military Operations*

**20020016343** Defence Research Establishment Valcartier, Information and Knowledge Management Section, Val Belair, Quebec Canada
**Performance Management of C2ISs through QoS**
Dorion, Eric, Defence Research Establishment Valcartier, Canada; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 16-1 - 16-8; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper emphasizes the importance of performance management of Command and Control Information Systems (C2ISs) in the context of a coalition. It describes some of the concepts that are being developed or used at DREV (Defence Research Establishment Valcartier) for ensuring that performance and efficiency in systems can be reproduced and improved instead of applying ad hoc solutions. The concept of Quality of Service (QoS) is adapted to our needs and key technology aspects are considered.
Author
*Command and Control; Information Systems; International Cooperation*

**20020016346** Physics and Electronics Lab. TNO, The Hague, Netherlands
**Network Centric Operations: Implications for Allied and Coalition Operations**
Keus, Hans E., Physics and Electronics Lab. TNO, Netherlands; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 19-1 - 19-8; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Network Centric Warfare (NCW) or perhaps a better term would be Network Centric Operations (NCO) is rapidly becoming one of the areas where the most likely progress in efficiency and effectiveness of military operations will take place. The benefits of information technology and specifically network technology in the civil business area are starting to become known in the military domain too. In the US a lot of attention is given to NCW to start adapting US forces to the ideas of NCO. However, little is known about how to achieve coalition-based NCO. This paper will go into some detail in discussing issues involved in Coalition-based NCO or CNCO as we will call it. After a short summary of the main issues of NCO we will try to identify some of the most important key factors involved in CNCO and discuss some of these items. Special attention will be given to concepts of interoperability. A migration path based upon the proposed methodological approach is suggested as a means to achieve CNCO.
Author
*Information Systems; Interoperability; Military Operations; International Cooperation*

**20020016347** National Aerospace Lab., Information and Communication Technology Div., Amsterdam, Netherlands
**A Road Map to the NATO Virtual Enterprise**
vandeVijver, Y. A. J. R., National Aerospace Lab., Netherlands; Stil, J. G., National Aerospace Lab., Netherlands; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 20-1 - 20-11; In English; Also announced as 20020016329; Original contains color illuatrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In this paper, information management challenges are described, and ways to achieve coalition interoperability, by defining a road map towards a NATO (North Atlantic Treaty Organization) virtual enterprise. Such an enterprise strongly supports the 'interoperable communications' target of the Defense Capabilities Initiative (DCI), launched at the NATO summit in Washington, April 1999. The building blocks of virtual enterprises will be discussed. These blocks are increasingly becoming standards, therefore allowing higher and higher levels of abstraction in interoperability. Starting from a historical example, and continuing with a Joint Warrior Interoperability Demonstration and results from a recent research program, this paper will describe the

journey on the road to the NATO Virtual Enterprise. The paper will be concluded by looking forward to the goal and discuss the road towards it.
Author
*Information Management; Interoperability; North Atlantic Treaty Organization (NATO)*

**20020017272** National Defence Research Establishment, Stockholm, Sweden
**FDTD Method of ELFE Propagation in Seawater**
Abrahamsson, L.; Dec. 2000; 30p; In English
Report No.(s): PB2001-108435; FOA-00-01735-409-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The finite-difference time-domain (FDTD) method has been the most prominent numerical method for electromagnetic problems since the beginning of the computer era. However, only recently it has been applied to electromagnetic radiation from sources in conductive media such as seawater. ELFE (extremely low frequency electromagnetic) propagation in marine environments is of great importance in undersea warfare technology (mine detection, signature models etc). The presence of media (air, seawater, seabed) with vastly different wave velocities leads to severe problems in the numerical treatment. This report contains a thorough description of these difficulties, and how they may be resolved. The main result of this work is a proposal on an improved FDTD technique, which implies that it is beneficial to use a combination of explicit and implicit time stepping. This development is carried out in collaboration with DERA UK, King's College London and Uppsala University.
NTIS
*Electromagnetic Radiation; Electromagnetic Wave Transmission; Marine Environments; Sea Water; Finite Difference Time Domain Method*

**20020017469** National Defence Research Establishment, Linkoeping, Sweden
**Distributed Jamming System Control--Preliminary Study** ***Distribuerad Stoersystemstyrning; Foerberedane Studie***
Andersson, J.; Erkstam, M.; Gezelius, J.; Kalian, J.; Karlsson, P.; Dec. 2000; 204p; In Swedish
Report No.(s): PB2001-108444; FOA-R-00-01722-616-SE; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
During the autumn 1999 and the spring 2000 a group of students at the Linkoping Institute of Technology carried out a project course in which FOA had given the group a task to solve. The object of the project course, 'Software project in a comprehensive view' (Programvaruprojekt I ett helhetsperspektiv-PUM), is primarily to acquire knowledge of how to realize a larger software project. The group was given the task to construct a flexible and distributed management system intended to use in jamming systems. The result is a software based communications system that manages several clients without the existence of a dedicated server. The system is implemented in Java and uses TCP/IP as the technical communication protocol between the clients. The development of the system has been strictly divided into separate layers; communication, engine, rules and user interface. This makes it possible to substitute and develop specific layers using the well-defined interfaces. This report is a compilation of the final documentation that the group has produced; requirement specifications, design specifications, technical documentation, and the users guide.
NTIS
*Jamming; Communication Networks; Distributed Processing; Design Analysis*

**20020017474** National Defence Research Establishment, Linkoeping, Sweden
**Algorithm Selection and Capacity Analysis in Digital Signal Processing**
Stroemberg, D.; Dec. 2000; 32p; In Swedish
Report No.(s): PB2001-108419; FOA-R-00-01821-408-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The range of selectable algorithms and computer architectures that can process data from digitized array antennas in radar applications is discussed. The requirements on computer capacity are large due to very large volumes of data produced per time unit. The development status for high performance computer architectures is described. Performance measures for parallel computer systems are presented, as are examples of signal processing algorithms and commercial computer architectures. The requirements to do high performance signal processing methods are identified and tracked. The report is based on studies of literature. The needs for research are identified.
NTIS
*Algorithms; Signal Processing; Parallel Computers; Data Processing; Parallel Processing (Computers)*

**20020018016** Helsinki Univ. of Technology, Electromagnetics Lab., Espoo, Finland

**Generalized Soft-and-Hard Surface**

Lindell, I. V.; Sep. 2000; 18p; In English; Also published as REPT-342

Report No.(s): PB2001-107369; ISBN 951-22-5172-8; Copyright; Avail: National Technical Information Service (NTIS)

Soft-and-hard surface (SHS) is a mathematical idealization of the tuned corrugated boundary. The boundary conditions are defined by a single real vector parallel to the corrugations. The SHS boundary was recently generalized by replacing the real vector by a complex vector and its conjugate. In the present study the SHS boundary is generalized one step further by defining it in terms of two complex vectors tangential to the surface. It is shown that, in analogy to the previous special cases, there exist two eigenpolarizations TE and TM with respect to the two vectors for plane waves of any angle of incidence. These two specially polarized waves see the boundary as a simple perfect magnetic or electric conductor surface, respectively. Because the same is true for TE and TM parts of fields radiated by finite sources. It is possible to apply the classical image theory for the computation of fields in the presence of a planar generalized SHS boundary. A principle of realization of such a boundary is briefly discussed. If the two vectors defining the boundary can be realized in practice, a device transforming and given polarization to any other polarization in reflection appears feasible.

NTIS

*Eigenvectors; Boundary Conditions; Corrugating; Electromagnetism; Polarization (Waves); Surface Geometry*

**20020018023** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Building and measuring a high performance network architecture**

Kramer, W. T. C.; Toole, T.; Fisher, C.; Dugan, J.; Wheeler, D.; Apr. 20, 2001; 31p; In English

Report No.(s): DE2001-785261; LBNL-47274; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Once a year, the SC conferences present a unique opportunity to create and build one of the most complex and highest performance networks in the world. At SC2000, large-scale and complex local and wide area networking connections were demonstrated, including large-scale distributed applications running on different architectures. This project was designed to use the unique opportunity presented at SC2000 to create a testbed network environment and then use that network to demonstrate and evaluate high performance computational and communication applications. This testbed was designed to incorporate many interoperable systems and services and was designed for measurement from the very beginning. The end results were key insights into how to use novel, high performance networking technologies and to accumulate measurements that will give insights into the networks of the future.

NTIS

*Architecture (Computers); Computer Networks*

**20020018038** Brigham Young Univ., Dept. of Electrical and Computer Engineering, Provo, UT USA

**A Comprehensive Investigation of Advanced Range Telemetry** ***Final Report, 1 Dec. 1998 - 30 Nov. 1999***

Rice, Michael, Brigham Young Univ., USA; Nov. 30, 1999; 39p; In English

Contract(s)/Grant(s): F49620-99-1-0056

Report No.(s): AD-A396785; AFRL-SR-BL-TR-01-0591; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Data from ARTM channel sounding flights has been analyzed. A three-path model consisting of a line-of-sight path and two reflected paths adequately captures all the essential multipath features of the aeronautical telemetry channel. The amplitudes and delays of the multipath reflections are the same for L-Band and S-Band. Antenna diameter does have an effect: larger antenna diameters result in lower amplitudes on the short-delay multipath reflection. Flight 18 data demonstrated a great deal of spatial diversity for two antennas with 40-foot vertical separation. An analysis of the effects of multipath on the bit error rate for BPSK matches measurements taken during the channel sounding flights. The dynamic behavior of the channel is measured using the Doppler power spectrum which have a bandwidth of about 10 Hz. Thus the coherence time of the channel is approximately 100 ms.

DTIC

*Telemetry; Multipath Transmission; Power Spectra*

**20020018624** Physics and Electronics Lab. TNO, The Hague, Netherlands

**Detection of Signals Below the Noise Floor** ***Final Report Detectie van Signalen Onder het Ruisniveau***

Lepelaars, E. S. A. M., Physics and Electronics Lab. TNO, Netherlands; Punt, J. B., Physics and Electronics Lab. TNO, Netherlands; August 2001; 98p; In Dutch; Original contains color illustrations; Sponsored in part by LAS, Prinses Juliana Kazerne, Netherlands

Contract(s)/Grant(s): TNO Proj. 30724.01.03

Report No.(s): TD00-0458; FEL-01-B150; Copyright; Avail: Issuing Activity

Current EW equipment can detect signals when they arrive at the EW receiver with a signal strength higher than the noise floor. A literature study shows no information is available. A correlation receiver has been modelled and simulated to determine the feasibility of detection. Results show that signals below noise levels can be detected,

Author

*Noise Intensity; Receivers; Signal Detection*

**20020018630** Physics and Electronics Lab. TNO, The Hague, Netherlands

**Analysis of Adcock Direction Finding with Two Incoming Signals** ***Final Report Peilanalyse van een Adcock Peil-Ontvanger met Twee Signalen***

Punt, J. B., Physics and Electronics Lab. TNO, Netherlands; deBijl, M. J., Physics and Electronics Lab. TNO, Netherlands; Dam, F. A. M., Physics and Electronics Lab. TNO, Netherlands; August 2001; 39p; In Dutch; Original contains color illustrations

Contract(s)/Grant(s): A98/KL/728; TNO Proj. 29500

Report No.(s): TD-2000-0403; FEL-00-A305; Copyright; Avail: Issuing Activity

Direction Finding (DF) of multiple signals causes problems in existing DF equipment, which has been built to determine just one direction. When multiple signals reach a Watson-Watt DF system, the CRT (cathode ray tube)-plots display peculiar figures. Based on image recognition and signal processing an attempt has been made to determine the direction of two non-coherent incoming signals. The image recognition method fails to perform adequately, mainly because the images were produced for the human eye - then processed by a computer again. Information is lost in this process. Signal processing delivers good results for most types of signals, and seems promising in that it doesn't need to know in advance whether two signals or just one signal are present. It does not function for coherent signals, though. Optimization and testing might prove the designed filter to be a very good replacement for the old DF processors working with Adcock receivers.

Author

*Direction Finding; Signal Processing; Pattern Recognition; Bearing (Direction)*

**20020018854** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden

**A Study of Surface Clutter in Bistatic Radar** ***En Studie av Markekon vid Bistatisk Radar***

Bjoerklund, S.; Nov. 1999; 104p; In Swedish

Report No.(s): PB2001-108070; FOA-R-99-01264-408-SE; No Copyright; Avail: National Technical Information Service (NTIS)

In bistatic radar, the transmitter and the receiver are geographically separated. This gives less vulnerability to anti-radiation missiles and jamming. It also results in better possibilities to detect stealth targets. There are several reasons to study surface clutter in bistatic radars. Surface clutter limits the sensitivity of the radar and must be suppressed in order to detect certain targets. The suppression can partly be performed by suitable beamforming at the receiver. Knowledge about the surface clutter is also needed to be able to calculate detection and false alarm probabilities, to perform optimal doppler filtering, and to determine dynamic range requirements. Other occasions when bistatic clutter appears are when the signals from jammers or the radar returns from low flying targets are reflected in the ground or the sea and when bistatic clutter signals from radar transmitters hit anti-radiation missiles. The objectives of this work has been to study bistatic surface clutter and to determine beamforming requirements at the receiver for clutter suppression. First, a literature survey has been made about bistatic surface clutter and one result of this work is an extensive reference list. Then, a model of the bistatic clutter scattering coefficient is compared with measured data. The conclusion is that the model is only suitable for 'in-plane' bistatic scattering, i.e. for the scattering in a plane orthogonal to the scattering surface. For 'out-of-plane' bistatic scattering a better model is needed. Next, a new expression for the bistatic clutter cell area for the important special case of the cell between the transmitter and the receiver is given. This area turns out to be considerable. to make it possible to specify beamforming requirements, two computer programs have been developed, which calculate the clutter power at the receiver antenna. The programs have been used in three radar applications, which show that the surface clutter is about the same for monostatic and bistatic pulsed radar except for short target ranges. In bistatic continuous-wave radar there are problems with the direct wave from the transmitter to the receiver and with surface clutter from the area between the transmitter and the receiver. Possible future work is a more accurate calculation of the clutter cell area and the received clutter power in certain

directions, an update of the literature survey, and studies of combined clutter suppression with transmitter beamforming, waveform choice, receiver beamforming, pulse compression and doppler filtering.
NTIS
*Radar Cross Sections; Multistatic Radar*

**20020018857** National Defence Research Establishment, Dept. of Command and Control Warfare Technology, Linkoeping, Sweden
**Transmission of Images Over a High Frequency Channel** ***Bildoeverfoering pa Kortvagskanal***
Fenander, E.; Dec. 1996; 64p; In Swedish
Report No.(s): PB2001-108087; FOA-R-96-00372-3.5-SE; No Copyright; Avail: National Technical Information Service (NTIS)
The Swedish Defense Research Establishment intends to demonstrate transmission of images using an experimental HF (High Frequency) radio system. The radio system that will be used has a bit rate of 1000 bit/s and a typical bit error rate of 10-20%. There is a possibility to use convolutional codes while transmitting. to obtain a reasonable transmission time the images must be compressed. The problem is to find a compression algorithm that is not too sensitive to transmission errors. We have simulated transmission of three images. The images have been represented in raw format, compressed by the UNIX command compress, by fractal coding and by JPEG (Joint Photographic Experts Group). The best result is achieved when using JPEG in sequential mode, with restart markers every other block. The file has to be protected by a Reed Solomon code and by a convolutional code. We have also considered postprocessing the images for error concealment. The obviously incorrect blocks are changed to more appropriate ones.
NTIS
*Data Compression; Coding; Image Processing; Radio Equipment*

**20020018863** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**Implementation of the Local Backprojection Algorithm on a Multicomputer**
Seger, O.; Herberthson, M.; Oct. 1999; ISSN 1104-9154; 30p; In English
Report No.(s): PB2001-108138; FOA-R-99-01255-408-SE; Copyright; Avail: National Technical Information Service (NTIS)
CARABAS (Coherent All Radio Band Sensing) is an airborne synthetic aperture radar with high relative bandwidth. Therefore it is possible to avoid the speckle problem that plagues conventional SAR. Furthermore CARABAS operates at radio band frequencies, which enables the radar to penetrate foliage and to some extent the ground. These unique features come at a price, however. The SAR processing algorithm for CARABAS is more complex than the conventional microwave SAR algorithm. Nevertheless it is possible an algorithm for reconstruction of CARABAS images. We also analyze the implementation of the algorithm on a multicomputer and measure the performance.
NTIS
*Airborne Equipment; Algorithms; Radio Frequencies; Synthetic Aperture Radar*

**20020018864** National Defence Research Establishment, Div. of Command and Control Warfare, Linkoeping, Sweden
**Characterization of the Radio Channel: The Armed Forces' Future Needs** ***Karakterisering av Radiokanalen. Foersvarsmaktens Modellbehov, nu och i Framtiden***
Asp, B.; Lundborg, B.; Loefsved, E.; Nov. 1999; 37p; In Swedish
Report No.(s): PB2001-108140; FOA-R-99-01299-504-SE; No Copyright; Avail: National Technical Information Service (NTIS)
The project activity 'Wideband channel models for VHF/UHF' terminates on December 31 1999. The aim of the activity has been to develop a wideband channel model which can serve as a trustworthy basis for simulation and evaluation of important parameters, such as throughput, for modern communication systems. At this point it is natural to look ahead and try to see what requirements will be put on channel models in the future. Do our channel models meet these requirements? If not, what further improvements need to be done and how can they be brought about? The report starts off by a discussion of the concept of a channel model in general, and a brief description of two models studied during the work. It continues with a more detailed presentation of our own ongoing work on the development of a wideband channel model. Thereafter we illuminate present and future requirements on channel models from several angles, for instance concerning different functionalities and applications. Finally, these discussion lead to recommendations for future work in the area.
NTIS
*Telecommunication; Radio Communication; Models*

**20020018871** Physics and Electronics Lab. TNO, The Hague, Netherlands

**High Resolution Techniques for Automatic Target Recognition in SAR Imagery** ***Final Report***

deVries, F. P. P., Physics and Electronics Lab. TNO, Netherlands; Steeghs, T. P. H., Physics and Electronics Lab. TNO, Netherlands; August 2001; 46p; In English

Contract(s)/Grant(s): A00/D6/01; TNO Proj. 29449

Report No.(s): TD-2000-0457; FEL-00-A250; Copyright; Avail: Issuing Activity

Manual image analysis and automatic-target-recognition algorithms are important aspects of ground surveillance radar systems. The performance of classification procedures strongly depends on resolution which is an expensive commodity to realize by hardware. Image resolution, however can be improved in a less expensive manner via digital signal processing. Modern super-resolution methods yield higher resolution than conventional Fourier processing. Compared are the images obtained by Fourier processing and the modern 2-D (two dimensional) high resolution method MUSIC. The latter is expected to yield higher resolution and clutter suppression. Also considered is the Space Variant Apodization (SVA) algorithm which suppresses the sidelobes of the Point Target Response, without broadening the main lobe. The Fourier, MUSIC, and SVA algorithms have been fed with synthetic data and real data from the Dutch PHARUS SAR (synthetic aperture radar) sensor and the results have been compared visually, though a controlled experiment would be required for a more quantitative assessment. The results clearly show the favorable impact that application of modern high resolution methods have on SAR imagery.

Author

*Algorithms; Image Resolution; Radar Imagery; Synthetic Aperture Radar; Target Recognition; Adaptive Optics*

**20020019014** Air War Coll., Maxwell AFB, AL USA

**Increased Military Reliance on Commercial Communications Satellites: Implications for the War Planner**

Jones, Duane A.; Apr. 1998; 40p; In English

Report No.(s): AD-A396984; AU/AWC/138/1998-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The October 1993 Department of Defense (DoD) Report on the Bottom-Up Review called for a greater reliance on commercial satellites for general-purpose military communications. This policy guidance was influenced in part by the Congressionally mandated Commercial Satellite Communications Initiative (CSCI) studies. As the DoD shifts to commercial platforms, what are the corresponding implications for the war planner? Drawing on information available in the public domain, this paper will attempt to determine whether commercial satellites offer new or increased vulnerabilities; and, if so, suggest new perspectives from which future war planners should view both the protection and denial of satellite communications.

DTIC

*Communication Satellites; Communication Networks; Military Operations*

**20020019040** Technische Univ., Lab. of Electromagnetic Research, Delft, Netherlands

**Modified Gradient and Contrast Source Inversion**

vandenBerg, P. M.; Aug. 1999; 21p; In English

Report No.(s): PB2002-100737; ET/EM-1999-15; Copyright; Avail: National Technical Information Service (NTIS)

This paper reviews the collaborative research of Kleinman and Van den Berg with respect to the inverse scattering problem of the determination of the shape, the location and the constitutive parameters of a local inhomogeneity from measurements of the scattered field when a monochromatic wave is incident upon the inhomogeneity. Since the inverse scattering problem is nonlinear, an algorithm for its solution is iterative in nature and each iteration requires the solution of a forward or direct problem. In order to avoid a full solution of the forward problem in each iteration, the Modified Gradient method was developed, in which a cost functional was minimized such that the unknown fields and contrast are updated simultaneously. This cost functional consist of the superposition of the mismatch of the measured field data with the field scattered by an object with a particular contrast function and the error in satisfying consistency in the interior of the object.

NTIS

*Algorithms; Gradients; Inverse Scattering; Inversions; Nonlinearity*

**20020019073** New Jersey Inst. of Tech., University Heights, NJ USA

**Numerical Modeling and Analysis of Transient Electromagnetic Wave Propagation and Scattering** ***Final Report, 1 Nov. 1998-30 Nov 2001***

Petropoulos, Peter G.; Sep. 18, 2001; 12p; In English

Contract(s)/Grant(s): F49620-99-1-0072

Report No.(s): AD-A396954; AFRL-SR-BL-TR-01-0606; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In 3 the P1 developed a scaling argument that proved useful in the derivation of reflectionless sponge layers to absorb outgoing time-harmonic waves in numerical solutions of the three-dimensional elliptic Maxwell equations in rectangular, cylindrical, and spherical coordinates. Also, this work developed these reflectionless sponge layers to absorb outgoing transient waves in numerical solutions of the time-domain Maxwell equations and proved that these absorbing layers are described by causal, strongly well-posed hyperbolic systems. A representative result was given for wave scattering by a compact obstacle to demonstrate the many orders of magnitude improvement offered by the developed approach over standard techniques for computational domain truncation.
DTIC
*Electromagnetic Wave Transmission; Elliptic Differential Equations; Mathematical Models; Numerical Analysis*

**20020019082** Applied Computational Electromagnetics Society, University, MS USA
**Applied Computational Electromagnetics Society Journal, Volume 16**
Miller, E. K.; Burke, G. J.; Eleiwa, M. A.; Elsherbeni, Atef Z.; Malan, D. H.; Nov. 2001; ISSN 1054-4887; 54p; In English
Report No.(s): AD-A396903; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Three different perspectives of electromagnetic radiation are presented here. The first employs the electric-field kink model, the second is based on a technique called FARS (Far-field Analysis of Radiation Sources), and the third uses time-domain solutions obtained from the TWTD (Thin-Wire Time Domain) model. The kink model demonstrates qualitatively that radiation is produced by ”wriggling” a charge. The latter two provide more quantitative results, showing that radiation for a straight dipole can come not only from the source region and ends but also from along its length.
DTIC
*Electromagnetic Fields; Electromagnetic Radiation; Far Fields; Computational Electromagnetics; Radiation Sources*

**20020019414** Space and Naval Warfare Systems Center, San Diego, CA USA
**Autonomous Vehicles and the Net-Centric Battlespace**
Fletcher, B.; Apr. 2000; 7p; In English; Published in Proceedings of the International Unmanned Undersea Vehicle Symposium, 24-28 Apr 2000
Report No.(s): AD-A397125; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Autonomous vehicles are playing increasing roles in the air/land/sea network of today’s battlespace. As the Navy’s lead laboratory for command, control, communications, ocean surveillance, and the integration of multiple-platform systems, Space and Naval warfare Systems Center San Diego has a unique perspective on the development and utilization of vehicles for these applications. A variety of autonomous systems and their roles will be discussed including remote sensor platforms, communication relays, and work platforms. As these capabilities are developed autonomous vehicles will become an integral component of the C4ISR (command, control, communications, computers, intelligence surveillance, reconnaissance) network.
DTIC
*Autonomy; Remote Sensors; Military Vehicles; Command and Control; Technology Utilization*

**20020020175** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Stochastic Modeling and Generation of Partially Polarized or Partially Coherent Electromagnetic Waves**
Davis, Brynmor, Arizona Univ., USA; Kim, Edward, NASA Goddard Space Flight Center, USA; Piepmeier, Jeffrey, NASA Goddard Space Flight Center, USA; [2001]; 41p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Many new Earth remote-sensing instruments are embracing both the advantages and added complexity that result from interferometric or fully polarimetric operation. to increase instrument understanding and functionality a model of the signals these instruments measure is presented. A stochastic model is used as it recognizes the non-deterministic nature of any real-world measurements while also providing a tractable mathematical framework. A stationary, Gaussian-distributed model structure is proposed. Temporal and spectral correlation measures provide a statistical description of the physical properties of coherence and polarization-state. From this relationship the model is mathematically defined. The model is shown to be unique for any set of physical parameters. A method of realizing the model (necessary for applications such as synthetic calibration-signal generation) is given and computer simulation results are presented. The signals are constructed using the output of a multi-input multi-output linear filter system, driven with white noise.
Author
*Electromagnetic Radiation; Remote Sensing; Stochastic Processes; Mathematical Models*

**20020020442** Yuan-Ze Univ., Dept. of Electrical Engineering, Taoyuan Taiwan, Province of China

**An Approach of Source Equivalance for the Fast Analysis of High Frequency Radio Wave Problems Via Uniform Geometrical Theory of Diffraction**

Lin, Der-Phone, Yuan-Ze Univ., Taiwan, Province of China; Chou, Hsi-Tseng, Yuan-Ze Univ., Taiwan, Province of China; Lin, Yu-Wen, Yuan-Ze Univ., Taiwan, Province of China; Chen, Hsin-Yi, Yuan-Ze Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; November 2001; ISSN 0253-3839; Volume 24, No. 6, pp. 723-733; In English; Copyright; Avail: Issuing Activity

Uniform geometrical theory of diffraction (UTD) is very efficient in the numerical analysis of electromagnetic (EM) wave problems associated with geometry of electrical]), large objects in comparison with ordinary numerical techniques such as method of moment (MoM) and finite difference in time domain (FDTD) because it extracts the most significant field contributions in terms of a very few ray optical fields. The UTD assumes fields radiated from a point source and suffers from difficulties in situations where the source volume is not extremely small, the object of interaction is very close to the source and only some source information is available. It is noted that discretization over the source for a numerical integration is Usually required in the prior two situations, which in turn degrades the expected efficiency of UTD. This paper describes a valid approach based on an equivalent representation of a source in terms of relatively few but simple elements that can be further modeled by an equivalent point source as required in UTD solutions. The source representation is obtained through a best guess from the available source information, and has potential to improve the efficiency and applicable areas of UTD to the greatest possible extent. Numerical examples are presented to validate the proposed approach.

Author

*Geometrical Theory of Diffraction; High Frequencies; Numerical Analysis; Finite Difference Time Domain Method; Radio Waves*

**20020020453** Naval Postgraduate School, Monterey, CA USA

**Bluetooth Technology and Its Implementation in Sensing Devices**

Aljuaied, Ali M.; Sep. 2001; 74p; In English; Original contains color images

Report No.(s): AD-A397232; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Bluetooth Wireless technology is the world's new short range RF transmission standard for small form factor, low cost, and short-range radio link between portable and desktop devices. This technology does not replace Wireless LANs rather it compliments them. Bluetooth wireless technology has many advantages over other Wireless LAN technologies, which makes it attractive to many applications. One such application is in the area of sensors and gauges on-board ships and submarines. If these are connected wirelessly, a huge amount of cables are eliminated and more user mobility is gained. This thesis studies the theories and principles of Bluetooth technology and discusses the approaches of connecting Bluetooth to sensors and gauges. Some of the Bluetooth products available in the market were acquired for testing and evaluation. In the course of the study, it was found that the technology was not mainly developed with sensor and gauge applications in mind. However, integrating sensors with Bluetooth modules can be achieved by one of two approaches. One approach requires an expensive Development Kit and is limited to manufacturers integrating Bluetooth technology into their sensor products in compliance with Bluetooth Specifications. The other inexpensive approach requires custom circuit designing and program coding and is preferred by university researchers.

DTIC

*Detection; Local Area Networks; Measuring Instruments; Modules*

**20020020458** Naval Postgraduate School, Monterey, CA USA

**Reorganization od the Marine Air Command and Control System to Meet 21st Century Doctrine and Technology**

Madsen, John C.; Sep. 2001; 70p; In English

Report No.(s): AD-A397181; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Marine Air Command and Control System (MACCS) is at a crossroad for organizational change. New and emerging war fighting doctrine, which places an emphasis on joint and small contingency operations, as well as new technology, requires flat the MACCS review bow it is organizationally structured. Within the next few years, the Marine Corps will field the Common Aviation Command and Control System (CAC2S). CAC2S is designed to be a singular tactical system for all functional agencies within the Marine Air Control Group (MACG). Unique systems, which were in the past tailored for the specific missions, will be eliminated with the fielding of CAC2S. CAC2S will allow the MACCS to operate in a manner that could not be achieved when the MACCS was first formed during the 1960's. Many sources in the Fleet Marine Force and the support establishment recognize that the MACCS must reorganize in order to operate and function effectively within the confines of this emerging 21st century technology and doctrine. Parallels exist between bow industry and business reorganize when introduced to new technologies and business doctrine, and the military. Organizational restructuring is something that must be carefully considered and planned, for

it is most often resisted by the members and stakeholders of an organization. Overcoming the barriers and resistance to change requires formal models of change be implemented. Technology alone cannot increase or improve an organization's productivity. Only through formal restructuring can an organization such as the MACCS hope to remain essential to the mission of the Marine Corps.
DTIC
*Command and Control; Military Technology*

**20020020465** Naval Postgraduate School, Monterey, CA USA
**Combined Adaptive Power-Rate Control in CDMA Systems**
Nalmpantis, Dimitrios; Sep. 2001; 50p; In English
Report No.(s): AD-A397142; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
In this thesis, combined power and rate adaptations in the reverse channel of a multicell CDMA cellular system over a Nakagami-Lognormal frequency selective fading channel are considered. Imperfect power control, user traffic distribution, Intracell interference, co-channel interference, a RAKE receiver and spatial diversity are also considered. Numerical results obtained by Monte Carlo simulation show that power and rate adaptations result in an increase of the system capacity and prolong the mobile station's battery life.
DTIC
*Adaptive Control; Code Division Multiple Access; Multipath Transmission; Radio Frequency Interference*

**20020021278** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**Mfactor 1.0 User Manual *Anvaendarhandledning Mfactor 1.0.***
Klum, P.; Rahm, J.; Rixon, K.; Bergstroem, L.; Larsson, C.; Sep. 2000; 30p; In Swedish
Report No.(s): PB2002-100658; FOA-R-00-01546-616-SE; No Copyright; Avail: National Technical Information Service (NTIS)
This document is a user manual for the computer program Mfactor 1.0. Using the program, the M-factor for different ship types in an attack scenario or in a measurement situation can be calculated. The M-factor describes, for an extended target above a sea surface, the amplification of the radar cross section (RCS) due to multipath (i.e. constructive and destructive interference between direct path and sea surface reflected path in a radar-target scenario). The M-factor can be used to convert measured values to free space values (RCS values for the measured object without the reflecting sea surface). The simulation is based upon target data calculated in FOPOL (physical optics) as 1-dimensional ISAR data (distribution of radar cross section in elevation in different target aspect angles). CAD descriptions of the target have been the input to FOPOL. In the program Mfactor 1.0 a target (ship) and its orientation relative an observer (radar) is defined with parameters like: position of the object, the observers antenna, sea wave height, frequency, etc. RCS distributions and observer positions (observer trajectories) are stored in external ASCII files that can easily be modified by the user. There are two different modes in the program: target rotation and M-factor diagram. In the target rotation mode, the M-factor is presented with a fixed observer position during a rotation of the target. In the M-factor diagram mode, the M-factor is presented with a fixed oriented target while the observer following a 'attack' trajectory is closing in on the target.
NTIS
*Computer Programs; Physical Optics; User Manuals (Computer Programs); Multipath Transmission*

**20020021283** National Defence Research Establishment, Div. of Command and Control Warfare, Linkoeping, Sweden
**Computational Efficiency and Bandwidth in Superresolution Circular Arrays**
Hyberg, P.; Dec. 1999; ISSN 1104-9154; 27p; In English
Report No.(s): PB2002-100593; FOA-R-99-01419-616-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
In a direction finding system that is to operate in real time, such as the SESAM system, computational efficiency is a key issue. However the best superresolution algorithms such as MUSIC and WSF do require a computationally heavy multidimensional search to find the DOA's, unless the array manifold can be given a Vandermonde structure. In the latter case efficient closed form algorithms such as the Root method exist. The problem of transforming the manifold of a sparse circular array into Vandermonde structure, and finding closed form 2D algorithms that work over at least two octaves of frequency, are considered in this report. The latter requirement makes it necessary to run the array with element separation much in excess of the Nyquist limit. Unfortunately this makes the only known 2D algorithm for circular arrays, UCS-ESPRIT, fail. A remedy to this problem is given comprising a transformation of the output vector from the array onto the corresponding output vector of an imaginary smaller array

that do comply with the Nyquist limit. The transformation hinges on the special property of circular arrays to retain full rank manifolds despite an element separation much in excess of the Nyquist limit.
NTIS
*Algorithms; Bandwidth; System Effectiveness; Signal Processing; Two Dimensional Models*

## 33
## ELECTRONICS AND ELECTRICAL ENGINEERING

*Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also 60 Computer Operations and Hardware; and 76 Solid-State Physics. For communications equipment and devices see 32 Communications and Radar.*

**20020016427** Bechtel Nevada Corp., Las Vegas, NV USA
**Gated IR Images of Shocked Surfaces**
Lutz, S. S.; Turley, W. D.; Rightley, P. M.; Primas, L. E.; Jun. 01, 2001; 4p; In English
Report No.(s): DE2001-783707; DOE/NV/11718-542; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Gated infrared (IR) images have been taken of a series of shocked surface geometries in tin. Metal coupons machined with steps and flats were mounted directly to the high explosive. The explosive was point-initiated and 500-ns to 1-microsecond-wide gated images of the target were taken immediately following shock breakout using a Santa Barbara Focalplane InSb camera (SBF-134). Spatial distributions of surface radiance were extracted from the images of the shocked samples and found to be non-single-valued. Several geometries were modeled using CTH, a two-dimensional Eulerian hydrocode.
NTIS
*Cameras; Infrared Radiation; Infrared Imagery; Radiance*

**20020016434** Argonne National Lab., IL USA
**High power test of the first s-band rf gun at SRRC**
Ho, C. H.; Chang, S. S.; Chiou, J. P.; Fann, C. S.; Hsu, K. T.; Jul. 23, 2001; 3p; In English
Report No.(s): DE2001-783665; ANL-HEP-CP-01-59; No Copyright; Avail: Department of Energy Information Bridge

We had constructed an S-band high power rf system at SRRC (Synchrotron Radiation Research Center). It will be used as a test bench of various designs of S-band rf guns. A 2856 MHz PFN (Pulse Forming Network) system was built to deliver 2 microseconds, 40KV voltage pulse at 10Hz repetition rate for the XK-5 Klystron. As a quick start, we had fabricated a 2856MHz single cell rf gun for the high power test. The recent results are reported.
NTIS
*Superhigh Frequencies; Synchrotron Radiation*

**20020016692** Sandia National Labs., Albuquerque, NM USA
**Solder Joint Reliability Predictions for Leadless Chip Resistors, Chip Capacitors, and Ferrite Chip Inductors Using the SRS Software**
Vianco,; Burchett,; Aug. 01, 2001; 59p; In English
Report No.(s): DE2001-783992; SAND2001-1665; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The SRS (trademark) software provided reliability predictions regarding the thermal mechanical fatigue (TMF) failure of solder joints for three sizes of chip resistor, three sizes of chip capacitor, as well as three sizes and three material compositions of ferrite chip components (inductors) assembled on a laminate printed wiring board. Four ”use” conditions and one accelerated testing condition were assessed using an end-of-life failure rate criterion of 10 ppm for the service conditions and an 50% end-of-life failure rate after accelerated testing. The chip resistors and capacitors would provide reliable electrical functionality over the entire product lifetime. Significant TMF in the gap location would reduce the mechanical strength of the joints. The ferrite components would also provide reliable electrical functionality over the entire product lifetime. A lower joint strength would be expected in some of the joints due TMF in the gap location. The accelerated test conditions were predicted to cause a decrease in mechanical strength for the resistor, capacitor, and ferrite component solder joints, more so in the case of the resistors and capacitors and to a lesser degree for the ferrite devices, due to TMF in the solder joint gap locations. However, a predicted absence

of TMF failure in the solder joint fillets would result in, no catastrophic loss of mechanical integrity or the loss of electrical performance to the solder interconnects of the devices.
NTIS
*Chips (Electronics); Soldered Joints; Capacitors; Inductors*

**20020017462** Eidgenoessische Technische Hochschule, Zurich, Switzerland
**ICONO'5 2000. 5th International Conference on Organic Nonlinear Optics. Davos, Switzerland, March 12-16, 2000** ***Final Report***
Mar. 16, 2000; 402p; In English
Report No.(s): AD-A396813; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche
Optical wave manipulation is one of the future technologies for optical processing and communication. Organic nonlinear optical materials are thought to have a key role in those technologies, and a lot of effort to develop new molecules/materials as well as fundamental understanding is under way throughout the world. ICONO'5 is the fifth International Conference on Organic Nonlinear Optics, a conference series that was started in Val Thorens, France, in January 1994. The conference aims at achieving international exchange of information and cooperation among researchers in academia, government laboratories, and industries, and to stimulate growth in the field of organic nonlinear optics. It provides a forum for discussion of all aspects of nonlinear optics, e.g. new phenomena, novel optoelectronic devices, and advanced organic materials.
DTIC
*Electro-Optics; Optical Materials; Optoelectronic Devices*

**20020017471** National Defence Research Establishment, Tumba, Sweden
**Performance and Characteristics of Frequency Estimators for Coherent Laser Radar Systems** ***Topical Report***
Morhagen, L.; Karlsson, C.; Carlsson, C.; Jun. 2000; 92p; In English
Report No.(s): PB2001-108432; FOA-R-00-01520-408-SE; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The aim of the studies in this thesis was to evaluate different methods for estimating parameters of signals originating from coherent laser radar systems, with a potentially very low signal-to-noise (SNR) ratio. Frequency estimating algorithms and values describing the confidence of the estimates have been studied. Many frequency estimators operate on data in the spectral domain. There are basically two different ways of producing estimates, by parametric models or from the data directly. Yule-Walker and Burg are the names of two different estimators both using parametric modeling. Other estimators that have been studied are the Lee, PP (pulse-pair), PG and PG2 algorithms. Lee's method uses a matched filter. The PP uses autocorrelation. The PG algorithms use the periodogram. For the studied signal parameters, the Lee estimator has the best performance. Excluding the knowledge of signal spectral width used by the Lee algorithm we find the PG2 algorithm to be the best. The PP algorithm works well for signals of large spectral widths.
NTIS
*Signal Processing; Radar; Coherent Radar; Autocorrelation; Frequencies; Estimating*

**20020018026** NASA Glenn Research Center, Cleveland, OH USA
**International Space Station Bus Regulation With NASA Glenn Research Center Flywheel Energy Storage System Development Unit**
Kascak, Peter E., Ohio Aerospace Inst., USA; Kenny, Barbara H., NASA Glenn Research Center, USA; Dever, Timothy P., QSS Group, Inc., USA; Santiago, Walter, NASA Glenn Research Center, USA; Jansen, Ralph H., Ohio Aerospace Inst., USA; September 2001; 10p; In English; 36th Intersociety Energy Conversion Engineering Conference, 29 Jul. - 2 Aug. 2001, Brook Park, OH, USA; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): RTOP 755-1A-09
Report No.(s): NASA/TM-2001-211138; E-12993; IECEC2001-AT-10; NAS 1.15:211138; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
An experimental flywheel energy storage system is described. This system is being used to develop a flywheel based replacement for the batteries on the International Space Station (ISS). Motor control algorithms which allow the flywheel to interface with a simplified model of the ISS power bus, and function similarly to the existing ISS battery system, are described. Results of controller experimental verification on a 300 W-hr flywheel are presented.
Author
*Flywheels; International Space Station; Systems Engineering; Electric Energy Storage; Bus Conductors; Synchronous Motors*

**20020018039** Wisconsin Univ., Dept. of Electrical and Computer Engineering, Madison, WI USA

**Instrumentation for Advanced, Slow-Waved, Microwave Vacuum Electron Device Research and Graduate Education** ***Final Report***

Booske, J. H.; Scharer, J.; Gilgenbach, R. M.; Lau, Y. Y.; Mar. 31, 2001; 13p; In English; Prepared in cooperation with University of Michigan, Ann Arbor

Contract(s)/Grant(s): F49620-00-1-0236

Report No.(s): AD-A396746; AFRL-SR-BL-TR-01-0599; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The equipment purchased with this DURIP grant has made possible new capabilities for fundamental research of vacuum electronics to support next generation U.S. military defense needs and objectives.

DTIC

*Education; Microwave Equipment; Measuring Instruments; Electronics; Vacuum Systems*

**20020018169** Netherlands Energy Research Foundation, Petten, Netherlands

**Bulk and Surface Passivation by Silicon Nitride Grown by Remote Microwave PECVD**

Soppe, W. J.; Devilee, C.; Schiermeier, S. E. A.; Weeber, A. W.; Hong, J.; Oct. 2001; 8p; In English; Original contains color illustrations

Report No.(s): PB2002-101084; ECN-RX-01-022; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Surface and bulk passivating properties of SiN,:H layers deposited by Remote Microwave PECVD (plasma enhanced chemical vapor deposition) are investigated. We found that the N/Si ratio of the layers is dependent of the substrate temperature, which suggests that the layer growth is dominated by an arrival of separate SiH and NH species at the surface and not by the arrival of SiN,Hy clusters formed in the plasma. SiNx:H layers with good surface passivating properties require different deposition conditions than layers with good bulk passivating properties. For good surface passivation, Si-rich layers are needed with relatively low H-concentrations. For layers which can provide good hydrogenation through firing, more stoichiometric and hydrogen rich layers are required in which the hydrogen is predominantly bonded to N-atoms. For p-type mc-Si Baysix wafers we found SiNx:H induced hydrogenation can improve the bulk lifetime of charge carriers by more than 20%. No synergistic effects of an A1 BSF on this hydrogenation process, however, were observed.

NTIS

*Silicon Nitrides; Passivity; Vapor Deposition*

**20020018832** Technische Univ., Centre for Technical Geoscience, Delft, Netherlands

**Estimation of the Average Contrast of a Buried Object**

Budko, N. V.; vandenBerg, P. M.; Jan. 1999; 13p; In English

Report No.(s): PB2002-100732; ET/EM-1999-02; Copyright; Avail: National Technical Information Service (NTIS)

The problem of estimation of the average contrast of a buried object is formulated as a nonlinear inverse scattering problem. An effective scattering model of reduced dimensionality is applied in order to make the inversion scheme numerically fast and well-posed. It is shown that a good estimate of the object's average constitution is obtained if a special metric is employed and the two-media background is replaced with the average homogeneous one. The effective scattering model is used in combination with Synthetic Aperture Radar (SAR) imaging, adding significant value to conventional SAR images.

NTIS

*Imaging Techniques; Inverse Scattering; Nonlinearity; Mathematical Models*

**20020018835** Technische Univ., Centre for Technical Geoscience, Delft, Netherlands

**Nonlinear Inversion in Three-Dimensional Cross-Well Induction Logging using Full-Vectorial Multi-Frequency Data**

Abubakar, A.; Haak, K. F. I.; vandenBerg, P. M.; Nov. 1998; 14p; In English

Report No.(s): PB2002-100733; ET/EM-1998-27; Copyright; Avail: National Technical Information Service (NTIS)

A method for reconstructing the electrical conductivity from the cross-well induction logging measurements is presented. This work extends the method previously developed for the electrode logging (static) case to the more complicated induction logging (below 100 kHz) case using full-vectorial multi-frequency data. The target is assumed to be located in an object domain D embedded in an unbounded homogeneous domain with conductivity. to reconstruct the conductivity of this object domain D from a knowledge of the secondary field, we assume that the object is illuminated successively by a number of divers point magnetic dipoles directed in the logging direction at the borehole axes, and at different frequencies with time factor exp.

NTIS

*Electrical Resistivity; Nonlinearity; Induction (Mathematics); Frequencies; Vectors (Mathematics); Inversions*

**20020018853** Helsinki Univ. of Technology, Metrology Research Inst., Espoo Finland

**Helsinki University of Technology Department of Electrical and Communications Engineering Metrology Research Institute** ***Annual Report, 1999***

Tittonen, I.; 2000; 74p; In English

Report No.(s): PB2001-108042; MRI-16/2000; Copyright; Avail: National Technical Information Service (NTIS)

Contents include the following: Introduction; Personnel; Teaching; Measurement Service; Research Projects; Photometry and Radiometry, Length Metrology, Fiber-Optic Measurements, Microtechnologies, and Applied Quantum Optics; International Co-Operation; and Publications.

NTIS

*Photometry; Metrology; Optical Measurement*

**20020018873** TNO Environment, Energy and Process Innovation, Apeldoom, Netherlands

**The Bipolar Lead-Acid Battery** ***Final Report, 1 Jan. 1998 - 31 Dec. 2000 De Bipolaire Loodzwavelzuur Batterij***

Saakes, M., TNO Environment, Energy and Process Innovation, Netherlands; Schmal, D., TNO Environment, Energy and Process Innovation, Netherlands; terVeen, W., TNO Environment, Energy and Process Innovation, Netherlands; Raadschelders, J. W., TNO Environment, Energy and Process Innovation, Netherlands; Dill, R., Prins Maurits Lab. TNO, Netherlands; vanGelder, P., Prins Maurits Lab. TNO, Netherlands; June 2001; 66p; In Dutch; Original contains color illustrations

Contract(s)/Grant(s): A98/KM/114; A98/KM/449; TNO Proj. 31544; TNO Proj. 31879; TNO Proj. 10550; TNO Proj. 12036

Report No.(s): TD-2000-0494; R-2000/0474; Copyright; Avail: Issuing Activity

Because of the growing need for high power electrical energy sources for pulse power and peak shaving on the future all-electric ship, further development has been carried out with respect to the TNO bipolar lead acid battery. The most important improvement on the battery components reached in the project described in this report, are related to the application of thinner bipolar plates and pasted electrode plates, better paste properties, thinner separator and spacer and lower cell resistance. These improvements have been successively incorporated in two 80 V prototypes which were built and tested in 1998 and 1999/2000. Furthermore, in 2000 a 4 V prototype has been made and tested, especially for pulse power tests. For this application a specific power of about 550 W/kg (2 x 4 s) has been realized. In parallel and partly combined attention has been paid to the development for non-military applications, especially hybrid electric vehicles. For this last application an improvement of specific power (now about 300 W/kg, 30 s) of about a factor 2 is still needed. In principle this is possible by using low weight materials for the grids (now lead) and some other components. For this further development into a producible prototype a European proposal for the fifth framework program is in preparation in cooperation with a number of industries in four countries. Beside that a proposal will be prepared for the military application (EUCLID). Beside the technology development, a battery model lay out has been made for system design and calculations, a rough market analysis has been made, five publications/presentations have been done and two patent applications have been filed.

Author

*Bipolarity; Lead Acid Batteries; Electrodes; Electrical Properties*

**20020018885** NASA Glenn Research Center, Cleveland, OH USA

**All-Optical Micro Motors Based on Moving Gratings in Photosensitive Media**

Curley, M., Alabama A & M Univ., USA; Sarkisov, S. S., Alabama A & M Univ., USA; Fields, A., Alabama A & M Univ., USA; Smith, C., Alabama A & M Univ., USA; Kukhtarev, N., Alabama A & M Univ., USA; Kulishov, M. B., Alabama A & M Univ., USA; Adamovsky, Grigory, NASA Glenn Research Center, USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 13; In English; Also announced as 20020018881

Report No.(s): P5; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

An all-optical micromotor with a rotor driven by a traveling wave of surface deformation of a stator being in contact with the rotor is being studied. Instead of an ultrasonic wave produced by an electrically driven piezoelectric actuator as in ultrasonic motors, the wave is a result of a photo-induced surface deformation of a photosensitive material produced by an incident radiation. A thin piezoelectric polymer will deform more easily LiNbO3 or metal when irradiated with light. The type of photosensitive material studied are piezoelectric polymers with and without coatings for connecting electrodes. In order to be considered as a possible candidate for micromotors, the material should exhibit surface deformation produced by a laser beam of the order of 10 microns. This is compared to the deformations produced by static holographic gratings studied in photorefractive crystals of LiNbO3 using high vertical resolution surface profilometer Dektak 3 and surface interferometer WYKO. An experimental setup showing the oscillations has been developed. The setup uses a chopped beam from an Argon ion laser to produce the deformation while a probe beam is reflected by the thin film into a fiber which is then detected on an oscilloscope. A ramp voltage signal generator will drive the piezoelectric film in another experiment to determine the resonance of the film. A current is generated

when light is incident upon the film and this current can be measured. The reverse process has already been demonstrated in other piezoelectric actuators. Changing voltage, polarity, and frequency of the signal can easily generate vibrations similar to those when light is incident on the film. This can be compared to the effects of laser interaction with light absorbing fluids such as solutions of 2,9,16,23-Tetrakis(phenylthio)-29H, 31 H-phthalocyanine in chlorobenzene in capillary tubes, The possibility of using a liquid with the piezoelectric film would be a novel idea for a micromotor since the interaction of a single low power focused laser beam at 633 nm with such fluid produced an intensive circular motion.
Author
*Photosensitivity; Micromotors; Incident Radiation*

**20020018904** Prairie View Agricultural and Mechanical Coll., Dept. of Electrical Engineering, TX USA
**Radiation Effects on DC-DC Converters**
Zhang, De-Xin, Prairie View Agricultural and Mechanical Coll., USA; AbdulMazid, M. D., Prairie View Agricultural and Mechanical Coll., USA; Attia, John O., Prairie View Agricultural and Mechanical Coll., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 31; In English; Also announced as 20020018881
Report No.(s): P23; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In this work, several DC-DC converters were designed and built. The converters are Buck Buck-Boost, Cuk, Flyback, and full-bridge zero-voltage switched. The total ionizing dose radiation and single event effects on the converters were investigated. The experimental results for the TID effects tests show that the voltages of the Buck Buck-Boost, Cuk, and Flyback converters increase as total dose increased when using power MOSFET IRF250 as a switching transistor. The change in output voltage with total dose is highest for the Buck converter and the lowest for Flyback converter. The trend of increase in output voltages with total dose in the present work agrees with those of the literature. The trends of the experimental results also agree with those obtained from PSPICE simulation. For the full-bridge zero-voltage switch converter, it was observed that the dc-dc converter with IRF250 power MOSFET did not show a significant change of output voltage with total dose. In addition, for the dc-dc converter with FSF254R4 radiation-hardened power MOSFET, the output voltage did not change significantly with total dose. The experimental results were confirmed by PSPICE simulation that showed that FB-ZVS converter with IRF250 power MOSFET's was not affected with the increase in total ionizing dose. Single Event Effects (SEE) radiation tests were performed on FB-ZVS converters. It was observed that the FB-ZVS converter with the IRF250 power MOSFET, when the device was irradiated with Krypton ion with ion-energy of 150 MeV and LET of 41.3 MeV-square cm/mg, the output voltage increased with the increase in fluence. However, for Krypton with ion-energy of 600 MeV and LET of 33.65 MeV-square cm/mg, and two out of four transistors of the converter were permanently damaged. The dc-dc converter with FSF254R4 radiation hardened power MOSFET's did not show significant change at the output voltage with fluence while being irradiated by Krypton with ion energy of 1.20 GeV and LET of 25.97 MeV-square cm/mg. This might be due to fact that the device is radiation hardened.
Author
*Voltage Converters (DC to DC); Radiation Effects; Ionizing Radiation; Radiation Dosage*

**20020018912** Tuskegee Inst., Electrical Engineering Dept., AL USA
**Study of Electrical Contacts and Devices in Advanced Semiconductors**
Hall, H. P., Tuskegee Inst., USA; Das, K., Tuskegee Inst., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 39; In English; Also announced as 20020018881
Report No.(s): P31; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Research conducted at Tuskegee University concentrates on electrical contacts to GaN films and their characterization with the objective of understanding contact formation and realizing low-resistance metal contacts. Contact properties are known to be strongly related to surface preparation. It appears that the as-received material had a thin oxide film on the surface of the GaN film. Various cleaning treatments were employed in order to render the surface contamination free and removal of the oxide film. Metal films were then deposited by e-beam evaporation. Electrical characteristics of these contacts indicated that the optimal treatment was an organic solvent cleaning followed by etching in buffered oxide solution. Contacts established with Al were observed to be ohmic in nature, whereas Au, Cr, Ti, and Pt exhibit rectifying contacts. Platinum contacts were almost ideal as shown by an ideality factor of 1.02.
Author
*Electric Contacts; Semiconductors (Materials); Metal Films; Contamination*

**20020019013** Virginia Polytechnic Inst. and State Univ., Dept. of Engineering Science and Mechanics, Blacksburg, VA USA
**Global/Local Design Optimization of a Power Distribution System** ***Final Report, 1 Feb.-30 Nov. 1999***
Gurdal, Zafer; Ragon, Scott; Lindner, Douglas; Mar. 31, 2000; 27p; In English

Contract(s)/Grant(s): F49620-99-1-0104
Report No.(s): AD-A396996; AFRL-SR-BL-TR-01-0611; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A mathematical optimization technique is used to design several components of a power distribution system for next generation aircraft. A simple interconnected system consisting of an input filter and a DC-DC buck converter is used as the prototype for the optimization demonstration. The components are designed for minimum weight subject to performance, stability, and peak voltage constraints. Optimized designs for each of the individual subsystems and for the integrated system are presented. It is shown that there is interaction between the filter design problem and the converter design problem, and that weight improvements can be obtained by taking these interactions into account. The automated design scheme described enables designers to obtain optimized subsystem designs in a time efficient manner.

DTIC

*Design Optimization; Voltage Converters (DC to DC); Electrical Engineering*

**20020020651** National Lien-Ho Inst. of Tech., Dept. of Electrical Engineering, Miao-Li, Taiwan

**A Frequency-Dependent Droop Scheme for Parallel Control of UPS Inverters**

Chiang, Hsuang-Chang, National Lien-Ho Inst. of Tech., Taiwan; Yen, Chi-Yung, National Lien-Ho Inst. of Tech., Taiwan; Chang, Kuo-Tsi, National Lien-Ho Inst. of Tech., Taiwan; Journal of the Chinese Institute of Engineers; November 2001; ISSN 0253-3839; Volume 24, No. 6, pp. 699-708; In English; Copyright; Avail: Issuing Activity

This paper presents a frequency-dependent droop scheme for paralleling UPS inverters with no control interconnection, so the inverters can be tightly connected with the load. At the fundamental frequency, the reference voltage of the inverter is generated as a reactor connected between the inverter and the load. The intention is to control the real and reactive power sharing of inverters with the Q-V and P-w droop scheme employed in the power system without needing it true transfer reactor. At the harmonic frequency, the reference voltage is generated as a resistor connected between the inverter and the load. The intention is that the load harmonic current can be shared equally and the voltage waveform distortion will be low. Two 1KVA single-phase inverters are designed and implemented, some simulation and experimental results are provided for demonstrating the effectiveness of the proposed approach.

Author

*Inverters; Waveforms; Computerized Simulation; Electrical Engineering; Harmonics; Frequency Distribution; Regulators*

**20020020670** Oak Ridge National Lab., TN USA

**Machine Approach for Field Weakening of Permanent-Magnet Motors**

Hsu, J. S.; Apr. 02, 2000; 5p; In English
Report No.(s): DE2001-11022; ORNL/CP-104228; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The commonly known technology of field weakening for permanent-magnet (PM) motors is achieved by controlling the direct-axis current component through an inverter, without using mechanical variation of the air gap, a new machine approach for field weakening of PM machines by direct control of air-gap fluxes is introduced. The demagnetization situation due to field weakening is not an issue with this new method. In fact, the PMs are strengthened at field weakening. The field-weakening ratio can reach 10:1 or higher. This technology is particularly useful for the PM generators and electric vehicle drives.

NTIS

*Electric Motor Vehicles; Permanent Magnets*

**20020020981** Fraunhofer-Inst., Inst. for Reliability and Microintegration, Berlin, Germany

**Abstracts - 3rd International Conference and Poster Exhibition, Micro Materials, MicroMat 2000**

Michel, B.; Winkler, T.; Werner, M.; Fecht, H.; Apr. 19, 2000; 445p; In English; Micro Materials: MicroMat 2000, 17-19 Apr. 2000, Berlin, Germany
Report No.(s): AD-A397027; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

The aim of this third congress is to identify and highlight the progress achieved since the MicroMat 97 concerning mainly the different fields of micro materials applications and bring together specialists from all over the world to discuss the recent trends. Because there has been observed a considerable interest in micromaterials characterization the MicroMat organizers have invited outstanding scientists and engineers to deliver plenary and key-note lectures in different fields of materials testing and simulation. In addition to the plenary lectures, invited session and key-note session lectures, the program covers various topics of the conference with 260 oral and about 70 poster presentations.

DTIC

*Abstracts; Conferences; Microelectronics; Nanotechnology*

## 34
## FLUID MECHANICS AND THERMODYNAMICS

*Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also 02 Aerodynamics.*

**20020016254** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Comparison of results obtained with two subsurface non-isothermal multiphase reactive transport simulators, FADES-CORE and TOUGHREACT**
Juncosa Rivera, R.; Xu, T.; Pruess, K.; Jan. 01, 2001; 38p; In English
Report No.(s): DE2001-783485; LBNL-47315; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

FADES-CORE and TOUGHREACT are codes used to model the non-isothermal multiphase flow with multicomponent reactive transport in porous media. Different flow and reactive transport problems were used to compare the FADES-CORE and TOUGHREACT codes. These problems take into account the different cases of multiphase flow with and without heat transport, conservative transport, and reactive transport. Consistent results were obtained from both codes, which use different numerical methods to solve the differential equations resulting from the various physicochemical processes. Here we present the results obtained from both codes for various cases. Some results are slightly different with minor discrepancies, which have been remedied, so that both codes would be able to reproduce the same processes using the same parameters. One of the discrepancies found is related to the different calculation for thermal conductivity in heat transport, which affects the calculation of the temperatures, as well as the pH of the reaction of calcite dissolution problem modeled. Therefore it is possible to affirm that the pH is highly sensitive to temperature. Generally speaking, the comparison was concluded to be highly satisfactory, leading to the complete verification of the FADES-CORE code. However, we must keep in mind that, as there are no analytical solutions available with which to verify the codes, the TOUGHREACT code has been thoroughly corroborated, given that the only possible way to prove that the code simulation is correct, is by comparing the results obtained with both codes for the identical problems, or to validate the simulation results with actual measured data.
NTIS
*Dissolving; Multiphase Flow; Computerized Simulation; Porous Materials*

**20020016394** NASA Ames Research Center, Moffett Field, CA USA
**Dynamics of Vapour Bubbles in Nucleate Boiling, 1, Basic Equations of Bubble Evolution**
Buyevich, Yu A., NASA Ames Research Center, USA; Webbon, Bruce W., NASA Ames Research Center, USA; [1995]; 1p; In English
Contract(s)/Grant(s): RTOP 199-61-62; No Copyright; Avail: Issuing Activity; Abstract Only

We consider the behaviour of a vapour bubble formed at a nucleation site on a heated horizontal wall. There is no forced convection of an ambient liquid, and the bubble is presumably separated from the wall by a thin liquid microlayer. The energy conservation law results in a variational equation for the mechanical energy of the whole system consisting of the bubble and liquid. It leads to a set of two strongly nonlinear equations which govern bubble expansion and motion of its centre of mass. A supplementary equation to find out the vapour temperature follows from consideration of heat transfer to the bubble, both from the bulk of surrounding liquid and through the microlayer. The average thickness of the microlayer is shown to increase monotonously with time as the bubble meniscus spreads along the wall. Bubble expansion is driven by the pressure head between vapour inside and liquid far away from the bubble, with due allowance for surface tension and gravity effects. It is resisted by inertia of liquid being placed into motion as the bubble grows. The inertia originates also a force that presses the bubble to the wall. This force is counteracted by the buoyancy and an effective surface tension force that tends to transform the bubble into a sphere. The analysis brings about quite a new formulation of the familiar problem of bubble growth and detachment under conditions of nucleate pool boiling.
Author
*Bubbles; Vapors; Walls; Gas-Liquid Interactions; Interfacial Tension; Nucleate Boiling*

**20020016466** NASA Ames Research Center, Moffett Field, CA USA
**Dynamics of Vapour Bubbles in Nucleate Boiling, 2, Evolution of Thermally Controlled Bubbles**
Buyevich, Yu A., NASA Ames Research Center, USA; Webbon, Bruce W., NASA Ames Research Center, USA; [1995]; 1p; In English
Contract(s)/Grant(s): RTOP 199-61-62; No Copyright; Avail: Issuing Activity; Abstract Only

The previously developed dynamic theory of growth and detachment of vapour bubbles under conditions of nucleate pool boiling is applied to study motion and deformation of a bubble evolving at a single nucleation site. The bubble growth is presumed

to be thermally controlled, and two components of heat transfer to the bubble are accounted of: the one from the bulk of surrounding liquid and the one due to heat conduction across a liquid microlayer formed underneath the bubble. Bubble evolution is governed by the buoyancy and an effective surface tension force, both the forces making the bubble centre of mass move away from the wall and, thus, assisting its detachment. Buoyancy-controlled and surface-tension-controlled regimes are considered separately in a meticulous way. The duration of the whole process of bubble evolution till detachment, the rate of growth, and the bubble departure size are found as functions of time and physical and operating parameters. Some repeatedly observed phenomena, such as an influence of gravity on the growth rate, are explained. Inferences of the model agree qualitatively with available experimental evidence, and conclusions pertaining to the dependence on gravity of the bubble radius at detachment and the whole time of the bubble development when being attached to the wall are confirmed quantitatively.
Author
*Bubbles; Conductive Heat Transfer; Gravitational Effects; Nucleate Boiling*

**20020016471** NASA Ames Research Center, Moffett Field, CA USA
**On the Dynamics of Computing a Chemically Relaxed Nonequilibrium Flow**
Sweby, P. K., Reading Univ., UK; Lafon, A., Direction des Recherches, Etudes et Techniques, France; Yee, H. C., NASA Ames Research Center, USA; [1994]; 1p; In English; ICFD Conference on Numerical Methods for Fluid Dynamics, 3-6 Apr. 1995, Oxford, UK; Sponsored by Institute for Computational Fluid Dynamics, UK
Contract(s)/Grant(s): RTOP 505-59-53; No Copyright; Avail: Issuing Activity; Abstract Only

In order to gain insights into the strong dependence of numerical solutions on initial data for finite time steps, a set of nonlinear test problems rich enough to capture the behavior of difference schemes were recently identified and the numerical basins of attraction for these problems were computed using commonly used time discretizations in CFD. Our study revealed a wealth of surprisingly nonlinear behavior of numerical schemes that were not observed before, in particular for the implicit time discretizations that are commonly used in CFD. The goal of this work is to apply these tools to study a practical model from non-equilibrium flowfield relaxation. This type of problem arises in chemically nonequilibrium hypersonic flows such as in a shock tube experiment or an expanding nozzle. Here we consider a reacting mixture of (N2, N) for an inviscid one-dimensional steady model. Preliminary numerical results indicate that, aside from the possibility of spurious numerical solutions being introduced by the time discretizations, limitations on the model for physical or accurate solutions may also play a part in the dynamics observed.
Author
*Numerical Analysis; Nonlinear Systems; Nonequilibrium Flow; Nitrogen; Inviscid Flow; Computational Fluid Dynamics*

**20020016477** Institut de Recherche sur les Phenomenes Hors d'Equilibre, Marseille, France
**IUTAM Symposium on Bluff Body Wakes and Vortex-Induced Vibrations (BBVIV-2)** ***Final Report, 13-16 Jun. 2000***
Leweke, T.; Bearman, P. W.; Williamson, C. H.; Jun. 16, 2000; 307p; In English; IUTAM Symposium on Bluff Body Wakes and Vortex-Induced Vibrations (BBVIV-2), 13-16 June, 2000, Carry-Le-Rouet, France
Report No.(s): AD-A396774; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

This special issue of the Journal of Fluids and Structures is the proceedings of the 2nd IUTAM Symposium on Bluff Body Wakes and Vortex-Induced Vibrations held at Carry-le-Rouet, France on 13-16 June 2000. Topical sessions included: wake fundamentals; vortex-induced vibrations, forced oscillations, sphere wakes, three-dimensional effects, three-dimensional instability, wake manipulation, wake control and flexible structures. A significant outcome of the meeting was the recognition of the advances being made by computational fluid dynamics (CFD).
DTIC
*Conferences; Bluff Bodies; Computational Fluid Dynamics; Vortices; Wakes*

**20020016478** Princeton Univ., Dept. of Material and Aerospace Engineering, NJ USA
**Shock Propagation and Supersonic Drag in Low Temperature Plasmas** ***Final Report, 1 Jan. - 30 Sep. 1998***
Miles, Richard B., Princeton Univ., USA; Feb. 1998; 315p; In English
Contract(s)/Grant(s): F49620-97-1-0497
Report No.(s): AD-A396775; AFRL-SR-BL-TR-01-0583; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

This grant supported an Air Force-sponsored workshop, "Understanding and Control of Ionized High-Speed Flows," which was conducted at Princeton University, February 26-27, 1998. In recent years, there has been a great deal of interest in the formation mechanisms and properties of air plasmas. This interest is, in part, motivated by experiments conducted in Russia and in the USA which indicate shock propagation in weakly ionized air plasmas is at a higher velocity than would be predicted by presently understood models. If this is, indeed, the case, such plasmas could be used for supersonic/hypersonic drag reduction.

In addition, atmospheric plasmas could influence flow control devices, electromagnetic attenuation, and hypersonic propulsion systems. As a consequence, the formation of such plasmas in atmospheric pressure environments, and the study of the properties of these plasmas, are of significant national interest.
DTIC
*Plasmas (Physics); Wave Propagation; Supersonic Drag; Shock Waves; Drag Reduction*

**20020016479** Louisiana Tech Univ., Dept. of Mathematics and Statistics, Ruston, LA USA
**Proposal for Sponsoring in First International Conference in DNS/LES** ***Final Report, 15 Nov. 1996 - 14 Nov 1997***
Liu, Chaoqun, Louisiana Tech Univ., USA; Nov. 14, 1997; 6p; In English
Contract(s)/Grant(s): F49620-97-1-0034
Report No.(s): AD-A396776; AFRL-SR-BL-TR-01-0590; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This conference, sponsored by the US Air Force Office of Scientific Research (AFOSR), was held in Louisiana Tech University, Ruston, Louisiana, USA on August 4-8. 1997. The conference attracted 93 participants from 16 countries all over the world including most leading scientists in the area of DNS and LES. Direct Numerical Simulation (DNS) refers to accurate numerical solution of three dimensional, time-dependent Navier-Stokes equations for both flow transition and turbulence. DNS is the only numerical approach dealing with the exact solution of 3-D time-dependent N-S equations without any ad hoc assumption and in which all time and space length scales are taken into account.
DTIC
*Direct Numerical Simulation; Navier-Stokes Equation; Large Eddy Simulation; Conferences*

**20020016485** NASA Ames Research Center, Moffett Field, CA USA
**Entropy Generation in Regenerative Systems**
Kittel, Peter, NASA Ames Research Center, USA; [1995]; 1p; In English; Cryogenic Engineering Conference, 17-21 Jul. 1995, Columbus, OH, USA
Contract(s)/Grant(s): RTOP 233-02-05; No Copyright; Avail: Issuing Activity; Abstract Only
Heat exchange to the oscillating flows in regenerative coolers generates entropy. These flows are characterized by oscillating mass flows and oscillating temperatures. Heat is transferred between the flow and heat exchangers and regenerators. In the former case, there is a steady temperature difference between the flow and the heat exchangers. In the latter case, there is no mean temperature difference. In this paper a mathematical model of the entropy generated is developed for both cases. Estimates of the entropy generated by this process are given for oscillating flows in heat exchangers and in regenerators. The practical significance of this entropy is also discussed.
Author
*Entropy; Regenerators; Mathematical Models; Heat Transfer*

**20020016487** NASA Ames Research Center, Moffett Field, CA USA
**A 3D High-Order Unstructured Finite-Volume Algorithm for Solving Maxwell's Equations**
Liu, Yen, NASA Ames Research Center, USA; [1995]; 1p; In English; 1995 IEEE/URSI Meeting, 18-23 Jun. 1995, Newport Beach, CA, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): RTOP 505-59-53; No Copyright; Avail: Issuing Activity; Abstract Only
A three-dimensional finite-volume algorithm based on arbitrary basis functions for time-dependent problems on general unstructured grids is developed. The method is applied to the time-domain Maxwell equations. Discrete unknowns are volume integrals or cell averages of the electric and magnetic field variables. Spatial terms are converted to surface integrals using the Gauss curl theorem. Polynomial basis functions are introduced in constructing local representations of the fields and evaluating the volume and surface integrals. Electric and magnetic fields are approximated by linear combinations of these basis functions. Unlike other unstructured formulations used in Computational Fluid Dynamics, the new formulation actually does not reconstruct the field variables at each time step. Instead, the spatial terms are calculated in terms of unknowns by precomputing weights at the beginning of the computation as functions of cell geometry and basis functions to retain efficiency. Since no assumption is made for cell geometry, this new formulation is suitable for arbitrarily defined grids, either smooth or unsmooth. However, to facilitate the volume and surface integrations, arbitrary polyhedral cells with polygonal faces are used in constructing grids. Both centered and upwind schemes are formulated. It is shown that conventional schemes (second order in Cartesian grids) are equivalent to the new schemes using first degree polynomials as the basis functions and the midpoint quadrature for the integrations. In the new formulation, higher orders of accuracy are achieved by using higher degree polynomial basis functions. Furthermore, all the surface and volume integrations are carried out exactly. Several model electromagnetic scattering problems are calculated and compared with analytical solutions. Examples are given for cases based on 0th to 3rd degree polynomial basis

functions. In all calculations, a centered scheme is applied in the interior, while an upwind matching scheme is employed at material interfaces and the Engquist-Majda non-reflecting boundary condition is implemented at the numerical outer boundaries. The staggered leapfrog scheme and the Runge-Kutta methods are utilized for the time integration. Excellent agreements are found between the numerical and analytical solutions.
Author
*Three Dimensional Models; Algorithms; Finite Volume Method; Maxwell Equation; Time Dependence; Numerical Analysis*

**20020016687** Sandia National Labs., Albuquerque, NM USA
**Microscale Zeta Potential Evaluation Using Streaming Current Measurements**
Hasselbrink, E. R.; Hunter, M. C.; Even, W. R.; Irvin, J. A.; May 01, 2001; 28p; In English
Report No.(s): DE2001-784197; SAND2001-8193; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We present a method for determination of zeta potential in capillaries and microscale devices. The use of streaming current measurements under pressure eliminates the need for high voltage measurements while providing a relatively simple means of approximating the zeta potential. This technique finds application in evaluation of coatings as well as materials for separations media and electrokinetic pumping. We will discuss the theory, in which sample porosity and tortuosity information are not required, and we will present zeta potentials of some organic and inorganic media.
NTIS
*Capillary Flow; Miniaturization*

**20020016708** NASA Langley Research Center, Hampton, VA USA
**Hypersonic Flows About a 25 degree Sharp Cone**
Moss, James N., NASA Langley Research Center, USA; December 2001; 22p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 706-85-40-02
Report No.(s): NASA/TM-2001-211253; NAS 1.15:211253; L-18122; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This paper presents the results of a numerical study that examines the surface heating discrepancies observed between computed and measured values along a sharp cone. With Mach numbers of an order of 10 and the freestream length Reynolds number of an order of 10 000, the present computations have been made with the direct simulation Monte Carlo (DSMC) method by using the G2 code of Bird. The flow conditions are those specified for two experiments conducted in the Veridian 48-inch Hypersonic Shock Tunnel. Axisymmetric simulations are made since the test model was assumed to be at zero incidence. Details of the current calculations are presented, along with comparisons between the experimental data, for surface heating and pressure distributions. Results of the comparisons show major differences in measured and calculated results for heating distributions, with differences in excess of 25 percent for the two cases examined.
Author
*Hypersonic Flow; Shock Tunnels; Slender Cones; Computerized Simulation; Numerical Analysis; Temperature Profiles; Free Flow*

**20020016864** NASA Langley Research Center, Hampton, VA USA
**Computational Investigation of the Performance and Back-Pressure Limits of a Hypersonic Inlet**
Smart, Michael K., Lockheed Martin Engineering and Sciences Co., USA; White, Jeffery A., NASA Langley Research Center, USA; [2002]; 20p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2002-0508; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche
A computational analysis of Mach 6.2 operation of a hypersonic inlet with rectangular-to-elliptical shape transition has been performed. The results of the computations are compared with experimental data for cases with and without a manually imposed back-pressure. While the no-back-pressure numerical solutions match the general trends of the data, certain features observed in the experiments did not appear in the computational solutions. The reasons for these discrepancies are discussed and possible remedies are suggested. Most importantly, however, the computational analysis increased the understanding of the consequences of certain aspects of the inlet design. This will enable the performance of future inlets of this class to be improved. Computational solutions with back-pressure under-estimated the back-pressure limit observed in the experiments, but did supply significant insight into the character of highly back-pressured inlet flows.
Author
*Hypersonic Inlets; Inlet Flow; Computerized Simulation; Wind Tunnel Tests*

**20020017253** NASA Ames Research Center, Moffett Field, CA USA

**Flow Visualization Techniques in Wind Tunnel Tests of a Full-Scale F/A-18 Aircraft**

Lanser, Wendy R., NASA Ames Research Center, USA; Botha, Gavin J., NASA Ames Research Center, USA; James, Kevin D., Sterling Federal Systems, Inc., USA; Bennett, Mark, Sterling Federal Systems, Inc., USA; Crowder, James P., X-Aero Systems, Inc., USA; Cooper, Don, San Jose State Univ., USA; [1994]; 4p; In English; 7th International Symposium of Flow Visualization, 11-14 Sep. 1995, Seattle, WA, USA

Contract(s)/Grant(s): RTOP 505-68-30; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The proposed paper presents flow visualization performed during experiments conducted on a full-scale F/A-18 aircraft in the 80- by 120-Foot Wind-Tunnel at NASA Ames Research Center. The purpose of the flow-visualization experiments was to document the forebody and leading edge extension (LEX) vortex interaction along with the wing flow patterns at high angles of attack and low speed high Reynolds number conditions. This investigation used surface pressures in addition to both surface and off-surface flow visualization techniques to examine the flow field on the forebody, canopy, LEXS, and wings. The various techniques used to visualize the flow field were fluorescent tufts, flow cones treated with reflective material, smoke in combination with a laser light sheet, and a video imaging system for three-dimension vortex tracking. The flow visualization experiments were conducted over an angle of attack range from 20 deg to 45 deg and over a sideslip range from -10 deg to 10 deg. The various visualization techniques as well as the pressure distributions were used to understand the flow field structure. The results show regions of attached and separated flow on the forebody, canopy, and wings as well as the vortical flow over the leading-edge extensions. This paper will also present flow visualization comparisons with the F-18 HARV flight vehicle and small-scale oil flows on the F-18.

Author

*F-18 Aircraft; Flow Distribution; Flow Visualization; Separated Flow; Vortices; Wind Tunnel Tests*

**20020018132** Brookhaven National Lab., Upton, NY USA

**Synchrotron X-Ray Study of Hydration Dynamics in the Synthetic Swelling Clay Na-Fluorohectorite**

Dimasi,; Fossum,; Dasilva,; Jul. 22, 2001; 8p; In English

Report No.(s): DE2001-785047; BNL-68531; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present time-resolved synchrotron x-ray diffraction from the swelling clay Na fluoro-hectorite during controlled hydration and dehydration. A comparison of bulk and surface scattering reveals that the time dependence of basal Bragg peak positions and intensities has two components, which come into play at distinct temperatures. Intercalation of water into the crystal structure commences at a temperature of about 60 C on a time scale on the order of one hour. by contrast, percolation of water into the porous medium has a characteristic time constant of 3-4 h. This is the rate limiting process for hydration of the interior of the clay for T is greater than 40 C. We suggest that the temperature-dependent percolation step may account for some of the hysteresis reported in earlier diffraction studies of the hydration of similar systems.

NTIS

*Clays; Dehydration; Fluoro Compounds; Hydration*

**20020018567** NASA Marshall Space Flight Center, Huntsville, AL USA

**Fundamental Boiling and RP-1 Freezing Experiments**

Goode, Brian, NASA Marshall Space Flight Center, USA; [2001]; 10p; In English; Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper describes results from experiments performed to help understand certain aspects of the MC-1 engine prestart thermal conditioning procedure. The procedure was constrained by the fact that the engine must chill long enough to get quality LOX at the LOX pump inlet but must be short enough to prevent freezing of RP-1 in the fuel pump. A chill test of an MC-1 LOX impeller was performed in LN2 to obtain data on film boiling, transition boiling and impeller temperature histories. The transition boiling data was important to the chill time so a subsequent experiment was performed chilling simple steel plates in LOX to obtain similar data for LOX. to address the fuel freezing concern, two experiments were performed. First, fuel was frozen in a tray and its physical characteristics were observed and temperatures of the fuel were measured. The result was physical characteristics as a function of temperature. Second was an attempt to measure the frozen thickness of RP-1 on a cold wall submerged in warm RP-1 and to develop a method for calculating that thickness for other conditions.

Author

*Boiling; Freezing; RP-1 Rocket Propellants; Cryogenics; Turbine Pumps*

**20020018826** Michigan Univ., Dept. of Mechanical Engineering and Applied Mechanics, Ann Arbor, MI USA

**Computations of Droplet/Flow Interactions in Sprays** ***Final Report, 1 Sep. 1999 - 28 Feb. 2001***

Tryggvason, Gretar; Oct. 02, 2001; 3p; In English

Contract(s)/Grant(s): F49620-97-1-0525; Air Force Proj. 3484

Report No.(s): AD-A396788; AFRL-SR-BL-TR-01-0597; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The behavior of liquid fuel sprays was studied by direct numerical simulations. Two- and three- dimensional simulations were used to determine both the formation of drops and their interaction with the ambient flow. The Navier-Stokes equations were solved by a finite difference/front tracking technique that allowed resolution of inertial and viscous forces as well as the inclusion of surface tension at the deformable boundary between the fuel and the air. to examine the primary atomization and the formation of drops, several simulations of the breakup of sheared immiscible interfaces have been done. Two-dimensional simulations were used to examine the initial breakup and to establish the necessary numerical resolution. A three-dimensional code using cylindrical coordinates and local grid refinement has been used to examine how the initial two-dimensional instability becomes a fully three-dimensional "fiber" that eventually breaks up into drops.

DTIC

*Drops (Liquids); Finite Difference Theory; Fuel Sprays; Interfacial Tension; Navier-Stokes Equation; Direct Numerical Simulation; Atomizing*

**20020018887** City Coll. of the City Univ. of New York, NY USA

**Remobilizing the Interface of Thermocapillary Driven Bubbles Retarded by the Adsorption of a Surfactant Impurity on the Bubble Surface**

Palaparthi, Ravi, City Coll. of the City Univ. of New York, USA; Maldarelli, Charles, City Coll. of the City Univ. of New York, USA; Papageorgiou, Dimitri, New Jersey Inst. of Tech., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 14; In English; Also announced as 20020018881

Report No.(s): P6; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Thermocapillary migration is a method for moving bubbles in space in the absence of buoyancy. A temperature gradient is the continuous phase in which a bubble is situated, and the applied gradient impressed on the bubble surface causes one pole of the drop to be cooler than the opposite pole. As the surface tension is a decreasing function of temperature, the cooler pole pulls at the warmer pole, creating a flow that propels the bubble in the direction of the warmer fluid. A major impediment to the practical use of thermocapillary to direct the movement of bubbles in space is the fact that surfactant impurities, which are unavoidably present in the continuous phase, can significantly reduce the migration velocity. A surfactant impurity adsorbed onto the bubble interface is swept to the trailing end of the bubble. When bulk concentrations are low (which is the case with an impurity), diffusion of surfactant to the front end is slow relative to convection, and surfactant collects at the back end of the bubble. Collection at the back lowers the surface tension relative to the front end setting up a reverse tension gradient. (This can also be the case if kinetic desorption of surfactant at the back end of the bubble is much slower than convection.) For buoyancy driven bubble motions in the absence of a thermocapillarity, the tension gradient opposes the surface flow, and reduces the surface and terminal velocities (the interface becomes more solid-like and bubbles translate as solid particles). When thermocapillary forces are present, the reverse tension gradient set up by the surfactant accumulation reduces the temperature-induced tension gradient, and can decrease to near zero the bubble's thermocapillary velocity. The objective of our research is to develop a method for enhancing the thermocapillary migration of bubbles which have be retarded by the adsorption onto the bubble surface of a surfactant impurity. Our remobilization theory proposes to use surfactant molecules which kinetically rapidly exchange between the bulk and the surface and are at high bulk concentrations. Because the remobilizing surfactant is present at much higher concentrations than the impurity, it adsorbs to the bubble surface much faster than the impurity when the bubble is formed, and thereby prevents the impurity from adsorbing onto the surface. In addition, the rapid kinetic exchange and high bulk concentration maintain a saturated surface with uniform surface concentrations. This prevents retarding surface tension gradients and keeps the thermocapillary velocity high. In our reports over the first 2 years, we presented numerical simulations of the bubble motion and surfactant transport which verified theoretically the concept of remobilization, and the development of an apparatus to track and measure the velocity of rising bubbles in a glycerol/water surfactant solution. This year, we detail experimental observations of remobilization. Two polyethylene oxide surfactants were studied, C12E6 (CH3(CH2)11(OCH2)6OH) and C10E8 (CH3(CH2)4(OCH2CH2)8OH). Measurements of the kinetic exchange for these surfactants show that the one with the longer hydrophobe chain C12E6 has a lower rate of kinetic exchange. In addition, this surfactant is much less soluble in the glycerol/water mixture because of the shorter ethoxylate chain. As a result, we found that C12E6 had only a very limited ability to remobilize rising bubbles because of the limited kinetic exchange and reduced solubility. However, C10E8, with its higher solubility and more rapid exchange was found to dramatically remobilize rising bubbles. We also compared our theoretical calculations to the experimental measurements of velocity for both the non-remobilizing and remobilizing surfactants and found excellent

agreement. We further observed that for C10E8 at high concentrations, which exceeded the critical micelle concentrations, additional remobilization was measured. In this case the rapid exchange of monomer between micelle and surfactant provides an additional mechanism for maintaining a uniform surface concentrations.
Author
*Thermocapillary Migration; Surfactants; Bubbles; Impurities*

**20020018888** City Coll. of the City Univ. of New York, Dept. of Chemical Engineering, NY USA
**Surfactant Facilitated Spreading of Aqueous Drops on Hydrophobic Surfaces**
Kumar, Nitin, City Coll. of the City Univ. of New York, USA; Couzis, Alex, City Coll. of the City Univ. of New York, USA; Maldareili, Charles, City Coll. of the City Univ. of New York, USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 15; In English; Also announced as 20020018881
Report No.(s): P7; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Microgravity technologies often require aqueous phases to spread over nonwetting hydrophobic solid surfaces. Surfactants facilitate the wetting of water on hydrophobic surfaces by adsorbing on the water/air and hydrophobic solid/water interfaces and lowering the surface tensions of these interfaces. The tension reductions decrease the contact angle, which increases the equilibrium wetted area. Hydrocarbon surfactants; (i.e., amphiphiles with a hydrophobic moiety consisting of an extended chain of (aliphatic) methylene -CH2- groups attached to a large polar group to give aqueous solubility) are capable of reducing the contact angles on surfaces which are not very hydrophobic, but do not reduce significantly the contact angles of the very hydrophobic surfaces such as parafilm, polyethylene or self assembled monolayers. Trisiloxane surfactants (amphiphiles with a hydrophobe consisting of methyl groups linked to a trisiloxane backbone in the form of a disk ((CH3)3-Si-O-Si-O-Si(CH3)3) and an extended ethoxylate (-(OCH2CH2)a-) polar group in the form of a chain with four or eight units) can significantly reduce the contact angle of water on a very hydrophobic surface and cause rapid and complete (or nearly complete) spreading (termed superspreading). The overall goal of the research described in this proposal is to establish and verify a theory for how trisiloxanes cause superspreading, and then use this knowledge as a guide to developing more general hydrocarbon based surfactant systems which superspread. We propose that the trisiloxane surfactants superspread because their structure allows them to strongly lower the high hydrophobic solid/aqueous tension when they adsorb to the solid surface. When the siloxane adsorbs, the hydrophobic disk parts of the molecule adsorb onto the surface removing the surface water. Since the cross-sectional area of the disk is larger than that of the extended ethoxylate chain, the disks can form a space-filling mat on the surface which removes a significant amount of the surface water. In this presentation, we report the results of measurements of the molecular packing and rates of kinetic exchange of the trisiloxane surfactants at the air/water interface in order to confirm our picture of trisiloxane packing, and provide additional insight into the superspreading process. We used the pendant bubble technique as a Langmuir trough to measure the trisiloxane equation of state which relates the tension to the surface concentration. From these measurements we obtain accurate values for the maximum packing density. We find that trisiloxanes with 4 and 8 ethoxylate groups have the same maximum packing concentration, indicating that the maximum packing is controlled by the cross section of the head group. For trisiloxanes with larger than eight ethoxylates, the maximum packing increases with ethoxylate number, indicating that the disposition of the ethoxylate chain (i.e., its effective size) is controlling. This supports our picture of superspreading: The superspreading ability of trisiloxanes decreases considerably for trisiloxanes with larger than eight ethoxylates; the packing measurements indicate that for the higher ethoxylate number trisiloxanes, the compact nonpolar head groups are pushed apart by the ethoxylate chain. They leave spaces of surface water on adsorption and do not lower the solid tension as much as their lower chain analogues. Finally the report measurements of the dynamic tension reduction accompanying the adsorption of trisiloxanes onto an initially clean interface using the pendant bubble technique, and we obtain from these relaxations, the equation of state and a mass transfer model, the rate constants for kinetic exchange. We find that the rate constants for desorption of trisiloxanes are generally much slower than for analogous aliphatic polyethoxylate surfactants with identical ethoxylate chain lengths. When an aqueous drop of a superspreader solution is placed on a hydrophobic surface and begins to spread, the lower desorption rates allows the tension at the drop center to remain reduced relative to the tension of the expanding periphery, thus strengthening Marangoni forces which can assist the spreading. Marangoni forces can be especially significant in the case of superspreaders because their maximum equilibrium reduction in tension is several dynes/cm lower than for aliphatic surfactants.
Author
*Surfactants; Spreading; Drops (Liquids); Hydrophobicity; Siloxanes*

**20020018890** City Coll. of the City Univ. of New York, Dept. of Mechanical Engineering, NY USA

**Experiments with Turbulent Jets at Mach Number 0.9**

Agui, Juan, City Coll. of the City Univ. of New York, USA; Andreopoulos, Yiannis, City Coll. of the City Univ. of New York, USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 17; In English; Also announced as 20020018881

Report No.(s): P9; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A systematic investigation of the structure of turbulent jets before their interaction with shock or expansion waves was undertaken during the last year. In particular compressibility and density effects in circular jets issuing in still air were investigated experimentally. Jets with nitrogen, helium, and krypton gases at 0.3, 0.6, and 0.9 Mach numbers were investigated in detail. Particle Image Velocimetry technique was developed, tested, and used to obtain qualitative information of the two-dimensional velocity field on a plane inside the flow field, which was illuminated by a laser sheet. The motion of particles was recorded by a CCD camera, which was appropriately triggered to capture two images within a fraction of a microsecond. Statistical averaging of the data at each location reduced the large amount of acquired data. It was found that the spreading rate of the jets was reduced with increased Mach numbers or increased density ratio. It was also found that decay rates of centerline Mach numbers are higher in gases with reduced density ratio. Mach number fluctuations appear to decrease with increasing Mach number of the flow. It has been proposed that the reason for this behavior is the reduction of vortex stretching activities with increased Mach number. Author

*Turbulent Jets; Mach Number; Compressibility Effects; Transonic Speed*

**20020018896** NASA Glenn Research Center, Cleveland, OH USA

**Numerical Simulation of One- and Two-Phase Flows in Propulsion Systems**

Gilinsky, Mikhail, Hampton Univ., USA; Patel, Kaushal, Hampton Univ., USA; Alexander, Casey, Hampton Univ., USA; Thompson, Tyesha, Hampton Univ., USA; Blankson, Isaiah M., NASA Glenn Research Center, USA; Shvets, Alexander I., Moscow State Univ., Russia; Gromov, Valery G., Moscow State Univ., Russia; Sakharov, Vladimir I., Moscow State Univ., Russia; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 23; In English; Also announced as 20020018881

Report No.(s): P15; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In this report, we present some results of problems investigated during joint research between the Hampton University Fluid Mechanics and Acoustics Laboratory (HU/FM&AL), NASA GRC, and the LaRC Hyper-X Program. This work is supported by joint research between the NASA GRC and the Institute of Mechanics at Moscow State University (IM/MSU) in Russia under a CRDF grant. The main areas of current scientific interest of the HU/FM&AL include an investigation of the proposed and patented advanced methods for aircraft engine thrust and noise benefits. These methods are based on nontraditional 3D corrugated and composite nozzle, inlet, propeller and screw designs such as a Bluebell and Telescope nozzle, Mobius-shaped screw, etc. This is the main subject of our other projects, of which one is presented at the current conference. Here we analyze additional methods for exhaust jet noise reduction without essential thrust loss and even with thrust augmentation. Such additional approaches are: (1) to add some solid, fluid, or gas mass at discrete locations to the main supersonic gas stream to minimize the negative influence of strong shock waves formed in propulsion systems. This mass addition may be accompanied by heat addition to the main stream as a result of the fuel combustion or by cooling of this stream as a result of the liquid mass evaporation and boiling; (2) Use of porous or permeable nozzles and additional shells at the nozzle exit for preliminary cooling of the hot jet exhaust and pressure compensation for off-design conditions (so-called continuous ejector with small mass flow rate); and (3) to propose and analyze new effective methods of fuel injection into the flow stream in air-breathing engines. The research is focused on a wide regime of problems in the propulsion field as well as in experimental testing and theoretical and numerical simulation analyses for advanced aircraft and rocket engines. The FM&AL Team uses analytical methods, numerical simulations, and experimental tests at the Hampton University campus, NASA, and IM/MSU. The main outcomes during this reporting period are: (1) Publications: The AIAA Paper #01-1893 has been accepted for the AIAA/NAL-NASDA-ISAS 10th International Space Planes and Hypersonic Systems and Technologies Conference, 24-27 April 2001, Kyoto, Japan. The AIAA Paper #01-3204 has been accepted for presentation at the 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference being held on 08-11 July, in Salt Lake City, UT; (2) Grants and proposals: The HU/FM&AL was awarded the NASA grant NAG3-2495 in October 2000 and the CRDF award was granted to the NASA GRC-HU FM&AL and IM/MSU (Russia) in July 2000. A solicited proposal was submitted for the NASA NRA-01GRC-02 competition and two unsolicited proposals to NASA are in preparation; (3) Theory and numerical simulations: Analytical theory, numerical simulation, comparison of theoretical with experimental results, and modification of theoretical approaches, models, grids, etc. Such investigations have been conducted for three main problems: (a) Combustion efficiency optimization in the half-duct combustor system; (b) Drag reduction effects for blunt bodies with solid needles; and (c) Solid particle injection from the butt-end against a supersonic flow. The NASA CFL3D, HU/FM&AL, and IM/MSU GODUNOV

codes were used and modified for solution of these problems. The codes are based on full Euler and Navier-Stokes solvers with and without nonequilibrium oxygen-nitrogen and air-hydrogen chemical reactions in laminar and turbulent gas flow regimes; (4) Experimental tests: In the IM/MSU supersonic wind tunnel, experimental tests were conducted with different number, location, and geometric parameters of solid needles mounted at the front of the butt-end in supersonic flow. Optimal parameters were determined that provide minimal butt-end drag in the stationary flow regime. Experimental and numerical simulation results are in good agreement; (5) Student Research Activity: Involvement of one graduate and two undergraduate students as research assistants in the current project.
Author
*Direct Numerical Simulation; Two Phase Flow; Propulsion System Performance; Jet Aircraft Noise; Jet Exhaust; Noise Reduction; Thrust*

**20020019009** Naval Postgraduate School, Monterey, CA USA
**Semi-Rigid Towing Model for Analysis of Maneuvering in the Horizontal Plane**
Jones, Garrett D.; Sep. 2001; 62p; In English
Report No.(s): AD-A397072; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
A SIMULINK towing model is developed from the surge, sway, and yaw equations of motion in order to study the horizontal maneuverability of vessels in a semi-rigid towing operation. This analysis is conducted in order to validate rigid-connection towing and to give insight into the design of the tow connector, The connection is modeled as a linear spring and the maneuverability of the vessels is studied as the stiffness is varied from conditions of semi to completely rigid. This study is based on two Swath hull vessels, the SLICE and KAIMALINO, towing in close proximity under calm water conditions,
DTIC
*Hydrodynamics; Towing; Maneuverability*

**20020019035** Institute for Computer Applications in Science and Engineering, Hampton, VA USA
**Band-gap Engineering in Sputter Deposited Amorphous/Microcrystalline Sc(x)Ga(1-x)N *Final Report***
Little, Mark E., Institute for Computer Applications in Science and Engineering, USA; Kordesch, Martin E., Ohio Univ., USA; November 2001; 11p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-2001-211241; NAS 1.26:211241; ICASE-2001-36; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Reactive sputtering was used to grow thin films of Sc(x)Ga(1-x)N with scandium concentrations of 20%-70% on quartz substrates at temperatures of 300-675 K. X-ray diffraction (XRD) of the films showed either weak or no structure, suggesting the films are amorphous or microcrystalline. Optical absorption spectra were taken of each sample and the optical band gap was determined. The band gap varied linearly with increasing Ga concentration between 2.0 and 3.5 eV. Ellipsometry was used to confirm the band gap measurements and provide optical constants in the range 250-1200 nm. ScN and GaN have different crystal structures (rocksalt and wurzite, respectively), and thus may form a heterogeneous mixture as opposed to an alloy. Since the XRD data were inconclusive, bilayers of ScN/GaN were grown and optical absorption spectra taken. A fundamental difference in the spectra between the bilayer films and alloy films was seen, suggesting the films are alloys, not heterogeneous mixtures.
Author
*Amorphous Materials; Microcrystals; Sputtering; Energy Gaps (Solid State); Scandium; Gallium Nitrides; Ellipsometry*

**20020019042** National Defence Research Establishment, Avd. foer Vapen och Skydd, Tumba, Sweden
**Homogenization by Multiple Scales Expansion of the Navier Stokes Equations**
Fureby, C.; Nov. 2000; 42p; In English
Report No.(s): PB2002-100694; FOA-R-99-01291-310-SE; Copyright; Avail: National Technical Information Service (NTIS)
In this study simulation models for turbulent incompressible viscous flow, governed by the Navier Stokes Equations (NSE), will be analyzed using homogenization by multiple scales expansion. Simulation models for turbulent incompressible viscous flow are generally derived by filtering the NSE over a finite interval of time, homogeneous directions or across an ensemble of equivalent flows providing the class of Reynolds Average Simulation (RAS) models, or by low-pass filtering in space, providing the class of Large Eddy Simulation (LES) or Very Large Eddy Simulation (VLES) models, depending on spatial resolution. Semi-empirical closure models must therewith be formulated to close the resulting RAS or LES equations. The motivation for the present work comes from the need to improve the simulation models for complex turbulent flows. More specifically, to extend the usefulness of LES-type models into the coarse grid/infinite Re number regime, and to let the model extend from a direct numerical simulation model, via LES and VLES, to a state-of-the-art Reynolds Simulation model. The use of the homogenization

method emphasises aspects of the filtered NSE and its relation to the closure modelling that has not been known before, which may aid in developing improved subgrid turbulence models and increasing our present understanding of turbulence.
NTIS
*Direct Numerical Simulation; Navier-Stokes Equation; Large Eddy Simulation; Homogenizing; Turbulence Models*

**20020019081** Zaragoza Univ., Spain
**Advances in Turbulence VIII**
Dopazo, C., Editor; Aug. 28, 2000; 1013p; In English, 27-30 Jun. 2000, Barcelona, Spain
Contract(s)/Grant(s): F61775-00-W-F020
Report No.(s): AD-A396907; EOARD-CSP-00-5020; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche
This is an interdisciplinary conference. Topics are related to fundamental aspects of Turbulence Physics and include the following fields: Instabilities and transition; Experimental techniques; Direct Numerical Simulation/Large Eddy Simulation; Compressible turbulence; Transport and mixing; Geophysical and environmental flows; Vortex dynamics; Intermittence and scaling; and Turbulent reacting flows.
DTIC
*Turbulent Flow; Turbulence; Large Eddy Simulation; Geophysics*

**20020019412** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA
**Reduced Order Modeling For High Speed Flows with Moving Shocks**
Lucia, David J.; Dec. 03, 2001; 181p; In English
Report No.(s): AD-A397155; AFIT/DS/ENY/01-03; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche
The use of Proper Orthogonal Decomposition (POD) for reduced order modeling (ROM) of fluid problems is extended to high-speed compressible fluid flows. The challenge in using POD for high-speed flows is presented by the presence of moving discontinuities in the flow field. to overcome these difficulties, a domain decomposition approach is developed that isolates the region containing the moving shock wave for special treatment. The domain decomposition implementation produces internal boundaries between the various domain sections. The domains are linked using optimization-based solvers which employ constraints to ensure smoothness in overlapping portions of the internal boundary. This approach is applied to three problems with increasing difficulty. The accuracy and order reduction of the domain decomposition POD/ROM approach is quantified for each application. ROMs with as large as three orders of magnitude reduction in degrees of freedom (DOFs) produce flow fields with maximum errors below 5%. One order of magnitude in computational savings for the non-Galerkin solver implementations accompanies this reduction in DOFs. Finally, the robustness of the reduced order models across a wide parameter space is demonstrated.
DTIC
*Compressible Fluids; Fluid Flow; Robustness (Mathematics); Mathematical Models; Shock Waves; High Speed*

**20020019552** NASA Ames Research Center, Moffett Field, CA USA
**Application of OVERFLOW to Hypersonic Perfect Gas Flowfields**
Olsen, M. E., NASA Ames Research Center, USA; Prabhu, D. K., Eloret Corp., USA; [2001]; 10p; In English; 15th AIAA Fluid Dynamics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-2664; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche
A validation of the matrix dissipation option in OVERFLOW was completed, and a single set of constants was found which yield good inviscid shock capturing, viscous heat and skin friction predictions, and work over a wide Mach and Reynolds number range. This scheme works well with multigrid, and produces fast convergence to steady state for 2 and 3 dimensional problems, with accuracy comparable to Roe upwinding, and without 'carbuncle' problems for the blunt body flowfields.
Author
*Computational Fluid Dynamics; Inviscid Flow; Applications Programs (Computers); Hypersonic Flow; Ideal Gas*

**20020019840** NASA Marshall Space Flight Center, Huntsville, AL USA
**Incorporation of Condensation Heat Transfer in a Flow Network Code**
Anthony, Miranda, NASA Marshall Space Flight Center, USA; Majumdar, Alok, NASA Marshall Space Flight Center, USA; [2001]; 22p; In English; 2001 Thermal Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
In this paper we have investigated the condensation of water vapor in a short tube. A numerical model of condensation heat transfer was incorporated in a flow network code. The flow network code that we have used in this paper is Generalized Fluid

System Simulation Program (GFSSP). GFSSP is a finite volume based flow network code. Four different condensation models were presented in the paper. Soliman's correlation has been found to be the most stable in low flow rates which is of particular interest in this application. Another highlight of this investigation is conjugate or coupled heat transfer between solid or fluid. This work was done in support of NASA's International Space Station program.
Author
*Heat Transfer; Computerized Simulation; Condensing; Computational Fluid Dynamics*

**20020020169** NASA Marshall Space Flight Center, Huntsville, AL USA
**Unsteady Flow in a Supersonic Turbine with Variable Specific Heats**
Dorney, Daniel J., NASA Marshall Space Flight Center, USA; Griffin, Lisa W., NASA Marshall Space Flight Center, USA; Huber, Frank, Riverbend Design Services, USA; Sondak, Douglas L., Boston Univ., USA; [2001]; 17p; In English; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Modern high-work turbines can be compact, transonic, supersonic, counter-rotating, or use a dense drive gas. The vast majority of modern rocket turbine designs fall into these Categories. These turbines usually have large temperature variations across a given stage, and are characterized by large amounts of flow unsteadiness. The flow unsteadiness can have a major impact on the turbine performance and durability. For example, the Space Transportation Main Engine (STME) fuel turbine, a high work, transonic design, was found to have an unsteady inter-row shock which reduced efficiency by 2 points and increased dynamic loading by 24 percent. The Revolutionary Reusable Technology Turbopump (RRTT), which uses full flow oxygen for its drive gas, was found to shed vortices with such energy as to raise serious blade durability concerns. In both cases, the sources of the problems were uncovered (before turbopump testing) with the application of validated, unsteady computational fluid dynamics (CFD) to the designs. In the case of the RRTT and the Alternate Turbopump Development (ATD) turbines, the unsteady CFD codes have been used not just to identify problems, but to guide designs which mitigate problems due to unsteadiness. Using unsteady flow analyses as a part of the design process has led to turbine designs with higher performance (which affects temperature and mass flow rate) and fewer dynamics problems. One of the many assumptions made during the design and analysis of supersonic turbine stages is that the values of the specific heats are constant. In some analyses the value is based on an average of the expected upstream and downstream temperatures. In stages where the temperature can vary by 300 to 500 K, however, the assumption of constant fluid properties may lead to erroneous performance and durability predictions. In this study the suitability of assuming constant specific heats has been investigated by performing three-dimensional unsteady Navier-Stokes simulations for a supersonic turbine stage.
Derived from text
*Supersonic Turbines; Unsteady Flow; Specific Heat; Computational Fluid Dynamics; Three Dimensional Models*

**20020020449** Naval Postgraduate School, Monterey, CA USA
**An Experimental Investigation of the Bow Wave on USS COLE (DDG-67)**
Markle, Howard B., II; Sep. 2001; 80p; In English
Report No.(s): AD-A397253; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This is an experimental investigation into the formation of the bow wave on USS COLE (DDG-67) and her 1/250 scale model. The experiment examines the bow wave from a hydrodynamic signature point of view. Previous experiments have looked at the phenomenon from an icing, deck wetness or hull resistance standpoint. Very little research has emphasized the importance to the Navy of the effects of the bow wave and subsequent spray on the overall radar cross-section and stealth of the vessel, Measurements were conducted on a 1/250-scale model and compared to video of the USS COLE (DDG-67) wherever possible, The effects of steady, heave, pitch and combinations of heave and pitch motions were studied to quantify the base flow in comparison to the USS COLE, The Froude Number for the majority of the work was 0,25, Model scale frequencies ranged from 1 to 5 Hz, pitch angles from 0,85 degrees to 3,75 degrees and heave amplitudes from 1/8 to 1/2 of an inch. This research, coupled with subsequent studies of sheet separation and a physics based understanding of all the mechanisms, is essential to developing a numerical model that could begin to predict the basics of the highly complex bow wave and spray region.
DTIC
*Bow Waves; Mathematical Models; Hydrodynamics; Ship Hulls*

**20020020972** Naval Postgraduate School, Monterey, CA USA
**Three-Component LDV Measurements of Corner Vortices over Second-Generation, Controlled-Diffusion, Compressor Blades in Cascade**
Caruso, Todd M.; Sep. 2001; 105p; In English; Original contains color images
Report No.(s): AD-A397132; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A detailed investigation of the three-dimensional flow in a cascade of second-generation controlled-diffusion compressor stator blades, at off-design inlet-flow angle, is reported. Three-component fiber-optic Laser-Doppler Velocimetry (LDV) surveys were made to fully map the flow at one plane upstream of the cascade and at three planes downstream. The measurements were performed at an inlet flow Mach number of 0.22 and a Reynolds number, based on chord length, of 640,000, The inlet surveys documented the approaching flow field in detail to establish the inlet boundary conditions for numerical simulations. At the downstream planes, total velocity distributions, total turbulence kinetic energy distributions, secondary flow velocity vector and contour plots are presented. The downstream surveys confined the existence of secondary flow vortices produced by the end wall. Surface vector and contour plots of non-dimensional velocity and total turbulence kinetic energy detail the complex flow field, including the size and location of the corner vortex system.
DTIC
*Laser Doppler Velocimeters; Three Dimensional Flow; Cascade Flow; Compressor Blades; Computational Fluid Dynamics*

**20020020978** Ballistic Research Labs., Aberdeen Proving Ground, MD USA
**Air Shock Filling of Model Rooms**
Coulter, George A.; Mar. 1968; 59p; In English
Report No.(s): AD-A397040; BRL-MR-1916; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The results of model room and chamber filling are given for two- and three-dimensional models exposed to shock waves 5-20 psi overpressure produced in the 4 x 15 in. and 24 in. shock tubes. Additional results are given for a field experiment in which a 3 ft cubic room was exposed to a 5 psi overpressure blast wave from the explosion of 100 tons of TNT. The results are presented on pressure-time filling records and on high speed photographs. A smoke grid technique was used to illustrate the shock filling process.
DTIC
*Shock Waves; Air Flow; Shock Tubes*

**20020020995** National Defence Research Establishment, Avd. foer Vapen och Skydd, Tumba, Sweden
**Pressure Distributions around Submarines and Ship Hulls**
Lillberg, E.; Alin, N.; Fureby, C.; Sep. 2000; ISSN 1104-9154; 29p; In English
Report No.(s): PB2002-100709; FOA-R-99-01285-313-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
It is of importance to the design of future sea-mine systems to obtain a thorough understanding of the flow and pressure distributions around surface ships and submarines. This report is concerned with numerical simulations of such flows using modern computational fluid dynamics models based on solving the full Navier Stokes equations. Detailed knowledge is obtained not only for the pressure fields, but also for the entire flow-field, including the Kelvin wave-pattern, and internal wave and the electromagnetic fields (if appropriate). Considering the pressure distribution around a typical submarine we have examined the pressure in the immediate vicinity of the hull of a Los Angeles class-type vessel and at two depths, corresponding to about 25m and 35m. Important differences are found, and the pressure at the sea-bed is linked to the hull form and speed through the pressure on the hull. Also the duration of the pressure disturbance caused by the submarine passage is evaluated and discussed. The dynamics of the wake of a surface ship is clearly observed also at the sea-bottom for finite depths where pressure fluctuations occur due to the ship motion and due to the turbulent motion of the water in its wake.
NTIS
*Computational Fluid Dynamics; Pressure Distribution; Ship Hulls; Submarines; Electromagnetic Fields; Mathematical Models*

**20020021192** Oregon Univ., OR USA
**Nucleation of Quantized Vortices from Rotating Superfluid Drops** ***Final Report***
Donnelly, Russell J., Oregon Univ., USA; [2001]; 12p; In English
Contract(s)/Grant(s): NAG3-1934; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The long-term goal of this project is to study the nucleation of quantized vortices in helium II by investigating the behavior of rotating droplets of helium II in a reduced gravity environment. The objective of this ground-based research grant was to develop new experimental techniques to aid in accomplishing that goal. The development of an electrostatic levitator for superfluid helium, described below, and the successful suspension of charged superfluid drops in modest electric fields was the primary focus of this work. Other key technologies of general low temperature use were developed and are also discussed.
Author
*Drops (Liquids); Liquid Helium 2; Nucleation; Rotation; Vortices*

## 35
## INSTRUMENTATION AND PHOTOGRAPHY

*Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Avionics and Aircraft Instrumentation; and 19 Spacecraft Instrumentation.*

**20020016146** Northrop Grumman Corp., Baltimore, MD USA
**Superconducting Material for IR Detector Arrays** ***Final Report, 30 Jun. 1993-1 Feb. 1998***
Talvacchio, John; Feb. 1998; 166p; In English
Contract(s)/Grant(s): F33615-93-C-5355; Proj-2423
Report No.(s): AD-A396799; AFRL-ML-WP-TR-2001-4137; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report describes the efforts to develop and evaluate high-T superconducting (HTS) materials for infrared detector arrays. The use of HTS materials and devices in infrared (IR) detectors was motivated by the very long wavelength cutoff at the superconducting energy gap (greater than 40 micron), immunity of superconductors to many radiation environments, and very fast response times. In addition, they offered the potential for Josephson-based preprocessors with analog-to-digital converters (ADC) operating at three orders of magnitude lower power than comparable semiconductors ADCs. Such low-power ADCs are an enabling technology for on-focal-plane (FPA) digitization of IR images and low-noise transfer of digital signals to off-plane images.

DTIC
*Infrared Detectors; Infrared Imagery; Superconductors (Materials); High Temperature Superconductors; Semiconductors (Materials)*

**20020016158** Florida Univ., Graduate Engineering and Research Center, Shalimar, FL USA
**Development of an All Electronic, Behind the Armor Debris Witness Panel** ***Final Report, 11 Jan. 1997-31 Mar. 2000***
Anderson, Chris; Jan. 17, 2001; 36p; In English
Contract(s)/Grant(s): F49620-98-1-0077; Proj-2304
Report No.(s): AD-A396721; AFRL-SR-BL-TR-01-0589; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents an AFOSR study performed by the UF GERC for a high speed diagnostic tool for characterizing the behind-armor effects of various armor defeating munitions. Regions behind the armor are continuously monitored with laser beams and photo-detectors so that passing fragments are detected when they temporarily shadow the detector outputs. During an event, all information is stored on a high speed, CCD detector based camera that is produced so as to store the high speed temporal information of the laser beam blockage. After the event, the camera data is digitized with a frame grabbing board and is subsequently digitally

DTIC
*Armor; Photometers; Laser Beams*

**20020016281** Sandia National Labs., Albuquerque, NM USA
**In-Axis and Cross-Axis Characterization of the ENDEVCO 7270A Accelerometer in a T05 Mechanical Package**
Bateman, V. I.; Brown, F. A.; Oct. 01, 2001; 30p; In English
Report No.(s): DE2001-787794; SAND2001-3192; No Copyright; Avail: Department of Energy Information Bridge

The characteristics of the ENDEVCO 7270A-60K piezoresistive accelerometer in a TO5 mechanical package are documented in this report. Both time-domain and frequency domain results are presented. This study was conducted because the TO5 mechanical package is a candidate for high volume production of the ENDEVCO 7270A and was performed at Sandia National Laboratories in the Mechanical Shock Laboratory. A titanium Hopkinson bar with an ENDEVCO 7270A in a TO5 mechanical package on a flyaway fixture in two different orientations was used for in-axis characterization up to 25,000 g. for a bandwidth of DC - 10,000 Hz.

NTIS
*Accelerometers; Characterization; Mechanical Properties*

**20020016465** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Microcalorimetry: The First Two Decades**
Moseley, Harvey, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Calorimetry 2001 Conference, 2001, Colorado Springs, CO, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Our group at GSFC began experimental and theoretical work on microcalorimetry almost twenty years ago, in August of 1982. Over the next 10 months, we completed the initial demonstration of a Si impurity thermometer-based calorimeter as an X-ray spectrometer. This successful demonstration resulted in the development by many investigators of scientific applications for microcalorimeters, ranging from optical spectroscopy to dark matter detection to particle physics applications. Many new technical approaches for cryogenic detectors were proposed by investigators and have been developed. In this presentation, I will describe the early development of microcalorimeters at GSFC and University of Wisconsin and the subsequent rapid growth of this work around the world The key milestones in the early development were the initial spectroscopy demonstrations and the selection of XRS, our microlcalorimeter-based instrument for the Advanced X-ray Astrophysics Facility (AXAF) and ultimately for ASTRO-E. An additional key event was the development of the direct detection of dark matter experiment and the formation of the Center for Particle Astrophysics. Both of these programs provided long term support for this technology in its precarious early days. A major additional technical step in the development of detectors was the demonstration of devices based on superconducting transition edge sensors (TES). These detectors promised (and have delivered) improved energy resolution and higher event rate capabilities. They couple naturally to SQUIDS, which operate well at the low temperatures where the detectors must operate. The past two decades have taken microcalorimeters from their infancy to applications in real experiments. I will provide an overview of the early development of the devices and review the breadth of the present technology and applications. Author

*Calorimeters; Numerical Analysis; Design Analysis; X Ray Spectrometers; Technology Utilization*

**20020016711** NASA Langley Research Center, Hampton, VA USA

**Comparison of Thermal Coefficients for Two Microwave Detectors**

Mackenzie, Anne I., NASA Langley Research Center, USA; December 2001; 22p; In English

Contract(s)/Grant(s): RTOP 258-80-00-32

Report No.(s): NASA/TM-2001-211258; NAS 1.15:211258; L-18091; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Laboratory measurements were performed to compare the thermal coefficients of two microwave detectors that might be used for direct detection in L-band radiometers. In particular it was desired to compare the performance of a new-technology flash ADC (analog-to-digital converter) against that of an older-technology diode detector in series with a VFC (voltage-to-frequency converter). The outputs of two state-of-the-art detectors were recorded as a constant 1.414-GHz signal was input and the physical temperatures of the detectors were varied over a range of 10 C. As a further experiment, each detector was tested with a noise diode source and with a sine wave synthesizer source. Thermal coefficients were computed in terms of W/C and in terms of ppt/C at nominal operating temperatures reasonable for the individual devices. Finally, thermal coefficients were calculated in K/C to indicate the change in brightness temperature seen by a theoretical sea surface salinity radiometer employing each detector. The K/C for the flash ADC was determined to be about 2.8 times that of the diode/VFC. Different reactions of the ADC to a noise input and a sine wave input indicated that ADC tests for radiometric purposes, such as this one, should be performed using a noise input. Author

*Detectors; Heat Transfer Coefficients; Frequency Converters; Microwave Radiometers; Ultrahigh Frequencies; Operating Temperature*

**20020016865** NASA Langley Research Center, Hampton, VA USA

**Structural Optimization of a Force Balance Using a Computational Experiment Design**

Parker, P. A., NASA Langley Research Center, USA; DeLoach, R., NASA Langley Research Center, USA; [2002]; 16p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0540; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper proposes a new approach to force balance structural optimization featuring a computational experiment design. Currently, this multi-dimensional design process requires the designer to perform a simplification by executing parameter studies on a small subset of design variables. This one-factor-at-a-time approach varies a single variable while holding all others at a constant level. Consequently, subtle interactions among the design variables, which can be exploited to achieve the design objectives, are undetected. The proposed method combines Modern Design of Experiments techniques to direct the exploration of the multi-dimensional design space, and a finite element analysis code to generate the experimental data. to efficiently search for an optimum combination of design variables and minimize the computational resources, a sequential design strategy was employed. Experimental results from the optimization of a non-traditional force balance measurement section are presented. An approach to overcome the unique problems associated with the simultaneous optimization of multiple response criteria is described. A quantitative single-point design procedure that reflects the designer's subjective impression of the relative

importance of various design objectives, and a graphical multi-response optimization procedure that provides further insights into available tradeoffs among competing design objectives are illustrated. The proposed method enhances the intuition and experience of the designer by providing new perspectives on the relationships between the design variables and the competing design objectives providing a systematic foundation for advancements in structural design.
Author
*Force Distribution; Structural Design; Design Optimization; Experiment Design; Computerized Simulation*

**20020017271** Stanford Linear Accelerator Center, CA USA
**Lectures on Warped Compactifications and Stringy Brane Constructions**
Kachru, S.; Jul. 26, 2001; 32p; In English
Report No.(s): DE2001-787177; SLAC-PUB-8641; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
In these lectures, two different aspects of brane world scenarios in 5d gravity or string theory are discussed. In the first two lectures, work on how warped compactifications of 5d gravity theories can change the guise of the gauge hierarchy problem and the cosmological constant problem is reviewed, and a discussion of several issues which remain unclear in this context is provided. In the next two lectures, microscopic constructions in string theory which involve d-branes wrapped on cycles of Calabi-Yau manifolds are described. The focus is on computing the superpotential in the brane worldvolume field theory. Such calculations may be a necessary step towards understanding e.g. supersymmetry breaking and moduli stabilization in string realizations of such scenarios, and one are of intrinsic interest as probes of the quantum geometry of the Calabi-Yau space.
NTIS
*String Theory; Gravitation Theory*

**20020018024** Alabama Univ., Huntsville, AL USA
**Management and Operation of the PED SLA Lab** ***Final Report, 1 Oct. 1998-30 Jun. 1999***
Paxton, Joseph; Jun. 1999; 4p; In English
Contract(s)/Grant(s): DAAH01-93-D-R001
Report No.(s): AD-A396839; UAH-5-20266; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The following parts have been built during 1999: (1) housing prototypes; (2) cover; (3) frame; (4) IMU Assembly; (5) closure and brackets; (6) motor; (7) MSU. In addition to these prototype builds, the following activities have taken place throughout the year: (1) presented lab capabilities at AMC Rapid Prototyping and Tooling Seminar at Redstone Arsenal on October 28, 1999; (2) conducted several tours throughout the year to market the lab capabilities to potential customers; (3) maintained a database of parts built in the lab throughout the year; (4) initiated plans for an intense marketing effort to increase the activity in the lab; (5) investigated the feasibility of installing Archimedes on the Silicon Graphics computer to assist with production and assembly analysis of systems.
Derived from text
*Rapid Prototyping; Lithography*

**20020018025** Alabama Univ., Huntsville, AL USA
**Management and Operation of the PED SLA Lab** ***Final Report, 1 Oct. 1999-30 Sep. 2000***
Paxton, Joseph; Sep. 2000; 4p; In English
Contract(s)/Grant(s): DAAH01-98-D-R001
Report No.(s): AD-A396835; UAH-5-20734; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The Production Engineering Division (PED), SEPD, MRDEC, AMCOM has the mission and function of providing rapid prototypes via SL to various AMCOM customers. The PED provides the following services to its customers: assistance in generating acceptable Computer Aided Design (CAD) files, delivering these files to the SL laboratory, building SL prototypes using both the ACES and QuickCast (QC) build styles, finishing prototypes to the customers' specifications, and facilitating the investment casting of QC prototypes. The PED requires engineering support in performing these SL tasks. The purpose of the work performed under this task order was to provide engineering support in producing SL prototypes for the PED customers.
DTIC
*Lithography; Rapid Prototyping*

**20020018037** Colorado Univ., Dept. of Chemistry and Biochemistry, Boulder, CO USA
**Scanning Probe Microscope for the Analysis of Thermal and Electrical Properties of Nanolaminates** ***Final Report, 31 Mar. 2000 - 30 Mar. 2001***
George, Steven M., Colorado Univ., USA; Oct. 22, 2001; 6p; In English

Contract(s)/Grant(s): F49620-00-1-0189; Air Force Proj. 3484
Report No.(s): AD-A396786; AFRL-SR-BL-TR-01-0593; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Funding of $144,540 was received for the purchase of a special scanning probe microscope (SPM) through the Defense University Research Instrumentation Program (DURIP). These funds were used to purchase a new SPM and related hardware for the analysis of nanolaminate thin films. An AutoProbe CP SPM was purchased from Thermomicroscopes in Sunnyvale, California for $121,499. A dektak3 Surface Profiler was also purchased from Veeco Metrology Group in Santa Barbara, California for $23,041. The instrumentation was received and installed and have been giving excellent results. This new instrumentation has significantly impacted our AFOSR-sponsored research and research-related education. The SPM and surface profilometer have greatly enhanced our ability to characterize the properties of nanolaminate thin films.

DTIC

*Scanning Electron Microscopy; Electrical Properties; Laminates; Nanocomposites; Thin Films*

**20020018573** Stanford Linear Accelerator Center, Stanford, CA USA

**DIRC Dreams Redux: Research Directions for the Next Generation of Internally Reflected Imaging Counters**

Ratcliff, B. N.; Sep. 18, 2001; 23p; In English
Report No.(s): DE2001-787237; SLAC-PUB-8989; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Some general conceptual design features of total internally reflecting, imaging Cherenkov counters (DIRCs) are described. Limits of the DIRC approach to particle identification and a few features of alternative DIRC designs are briefly explored.

NTIS

*Cerenkov Counters; Imaging Techniques*

**20020018827** Institute for Human Factors TNO, Soesterberg, Netherlands

**Head-Slaved Control Versus Joystick Control of a Remote Camera** ***Final Report***

deVries, S. C., Institute for Human Factors TNO, Netherlands; Jun. 07, 2001; 29p; In English
Contract(s)/Grant(s): 013.69032; TNO Proj. 788.1
Report No.(s): TD-2001-0142; TM-01-B008; Copyright; Avail: Issuing Activity

As part of TNO-HF's basic research we tried to answer the following questions. What is the best way to control the camera of a remotely controlled Unmanned Aerial Vehicle? Should we use a joystick or is head-tracking the way to go? In a simulator experiment, subjects were asked to control an unmanned aerial vehicle along a prescribed flight-path. The onboard camera could be either controlled by a joystick or by head movements. Its image was shown on a monitor or on a head-mounted display (HMD), respectively. We tested several joystick variants: a standard joystick, a joystick which integrated camera and UAV controls, and a joystick with force-feedback indicating camera orientation. Each of these three variants was tested with either position or velocity control of the camera. In a seventh joystick condition we used visual vehicle references. The results show no advantage of head-slaved control compared to joystick control. A clear difference was found between the two types of joystick dynamics: position control is better than velocity control. Finally, no advantage was found of vehicle references presented visually or haptically. Head-tracked control does not seem to be better than joystick control. Given the low quality of our HMD set-up the results may not be conclusive: more research is needed. The difference between earlier experiments showing positive effects of vehicle references and the current experiment was that the references used here were more 'artificial'. We therefore recommend references in fast-paced control tasks only it they are ecological in such a way that information processing is automatic and not cognitive.

Author

*Flight Simulators; Control Equipment; Helmet Mounted Displays*

**20020019008** Naval Postgraduate School, Monterey, CA USA

**The NPS Virtual Thermal Image Processing Model**

Lenter, Yucel; Sep. 2001; 193p; In English
Report No.(s): AD-A397073; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

A new virtual thermal image-processing model that has been developed at the Naval Postgraduate School is introduced in this thesis. This visualization program is based on an earlier work, the Visibility MRTD model, which is focused on predicting the minimum resolvable temperature difference (MRTD). The MRTD is a standard performance measure for forward-looking infrared (FLIR) imaging systems. It takes into account thermal imaging system modeling concerns, such as modulation transfer functions (MTFs), sampling, aliasing and noise, and provides virtual visual images that are associated with the thermal imaging system being modeled. This capability of the model allows the user to virtually evaluate the effects of component variation, noise, sampling and aliasing on the final four-bar image. The analysis demonstrated that aliasing effects in thermal images of four-bar

patterns cannot, in general, be adequately modeled as noise. For example, the simulation experiments showed that under the right conditions aliasing can create a noticeable contrast enhancement in the output images.
DTIC
*Image Processing; Thermal Mapping*

**20020019087** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Acoustic Microsensors, 5, Detection of the Hybridization of Oligonucleotides with the Piezoelectric Crystal Senor(2)** ***Final Report Akoestische Microsensoren, V, Detectie van de Hybridisatie van Oligonucleotiden met de Piezo-Elektrische Kristal Sensor (2)***
Harteveld, J. L. N., Prins Maurits Lab. TNO, Netherlands; September 2001; 32p; In English; Original contains color illustrations
Contract(s)/Grant(s): A93/KL/448; TNO Proj. 014.12828
Report No.(s): TD-2001-0057; PML-2001-A57; Copyright; Avail: Issuing Activity

Within the framework of the detection of biological warfare agents, the possibilities of the acoustic sensor to detect these agents were investigated. Detection was based on DNA hybridization instead of the more common immunochemically based detection. Preliminary results with DNA-based detection were more or less promising as described in the previous report. This report describes follow-up experiments in which the reproducibility, the detection limit and the ability to detect double-stranded DNA were investigated. Double-stranded DNA could be detected, with a detection limit of about 5 p g/ml. Although previous results could be reproduced, many experiments were needed to obtain results. The stability of the sensor system was and is a problem. The main reason for this instability is believed to be caused by the fixation of the crystal in the flow cell. Considering the progress made with real-time PCR coupled to fluorescence-based detection in our laboratory it was decided to skip all further research with the acoustic sensor.
Author
*Acoustics; Microinstrumentation; Piezoelectric Crystals; Sensors; Warfare*

**20020019148** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**Potential of Combined Active and Passive Electro-Optical Sensors**
Steinvall, O.; Letalick, D.; Sep. 2000; 72p; In English
Report No.(s): PB2002-100691; FOA-R-00-01605-408-SE; Copyright; Avail: National Technical Information Service (NTIS)

This report is a pre-study to find suitable concepts of combined active/passive EO systems for further research and exploitation. We have made an overview of laser sensing techniques of potential interest for future multisensor systems with emphasis on passive electro-optics. The passive channel may be used for wide area reconnaissance and the active for target recognition and fire control. Specific laser signatures such as 3-D, reflectivity (including retro-reflection), polarization, fluorescence and Doppler (including vibration) may be combined with a passive sensor, leading to a daylight independent sensor. Range information is of great value in target discrimination and to segment the intensity image. Increased performance for target detection and classification together with new functions (communication, countermeasures, autonomous behavior, etc.) can be obtained with such a combined system.
NTIS
*Electro-Optics; Sensors; Optical Radar; Autonomy; Target Recognition*

**20020019799** NASA Marshall Space Flight Center, Huntsville, AL USA
**Design and Fabrication of a Fabry-Perot Electrooptic Modulator**
Banks, C., Alabama A & M Univ., USA; Yelleswarapu, C., Alabama A & M Univ., USA; Sharma, A., Alabama A & M Univ., USA; Frazier, D., NASA Marshall Space Flight Center, USA; Penn, B., NASA Marshall Space Flight Center, USA; Abdeldayem, H., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; Alliance for NonLinear Optics Conference, 2 Nov. 2001, El Paso, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The research to design a Fabry-Perot electrooptic modulator with an intracavity electrooptically active organic material is based on the initial results of Wang et. al. [1] using poled polymer thin films. The main feature of the proposed device is the observation that in traditional electrooptic modulators like a Pockels cell, it requires few kilovolts of driving voltage to cause a 3 dB modulation even in high figure-of-merit electrooptic. materials like LiNbO3. The driving voltage for the modulator can be reduced to as low as 10 volts by introducing the electrooptic material inside the resonant cavity of a Fabry-Perot modulator. This is because the transmission of the Fabry-Perot cavity varies nonlinearly with the change of refractive index or phase of light due to applied electric field. We describe in this report the progress made so far in the design and fabrication of the proposed device.
Author
*Electro-Optics; Fabrication; Modulators; Fabry-Perot Interferometers; Design Analysis*

**20020020172** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Eratosthenes and Us, It Just Keeps Going and Going and Going...**

Romani, Paul, NASA Goddard Space Flight Center, USA; [2001]; 13p; In English; The Universe in the Classroom, Unknown; Sponsored by Astronomical Society of the Pacific, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We decided to duplicate Eratosthenes' measurement of the size of the Earth. Here we relate our experience the second time we did the project in 1998. This year was unique in that we were funded by a NASA IDEAS (Initiative to Develop Education through Astronomy and Space Science) grant to support curriculum development and a teachers' workshop.

Derived from text

*Radii; Earth (Planet)*

**20020020176** Thiokol Propulsion, Brigham City, UT USA

**B and F Signal Conditioner Checkout Unit**

Magleby, Alyssa, Thiokol Propulsion, USA; Nov. 15, 2001; 42p; In English

Contract(s)/Grant(s): NAS8-97238; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

ATK Thiokol Propulsion, Test Services uses B&F Signal Conditioning units to provide excitation power and shunt calibration information to the data recording systems. Gage measurements such as force, temperature, pressure, strain, etc. are recorded using this equipment. Approximately 2500 reusable instrumentation B&F Signal Conditioning units were purchased over an interval from 1978 to 1988 at a cost of around $1000 each. Through use and over time, the relay contacts on the signal conditioning mode cards have become corroded, resulting in excessive contact resistance. This causes inaccurate and inconsistent calibration data and could jeopardize the test results. These signal conditioning cards are needed for product testing for an estimated five more years, therefore, it is necessary to develop a solution to isolate the malfunctioning units for repair. The current screening method requires Test Area technicians to check cards manually, however the connections and measurements required for this process are inefficient and time consuming. to resolve this problem, funding was approved to design and build two B&F Signal Conditioner Checkout Units. Each unit will allow technicians to test relay contact resistance on signal conditioning mode cards before they are installed for data collection procedures. This tool will allow Test Area to resolve calibration accuracy problems and extend the life of the data acquisition equipment, as well as save troubleshooting time for the technicians.

Author

*Checkout; Measuring Instruments; Signal Processing; Systems Engineering*

**20020020447** NASA Marshall Space Flight Center, Huntsville, AL USA

**CZT Imaging Arrays for Space Applications**

Ramsey, Brian D., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; 12th International Workshop on Room-Temperature Semiconductor X and Gamma Ray Detectors, 5-10 Nov. 2001, San Diego, CA, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The compound CZT offers great promise for space applications with applications in such areas as radiation monitoring, planetary investigations and astrophysics. As crystal quality improves, the challenge for imaging array development is to derive electrode geometries and readout electronics to satisfy particular applications and to understand how the material will perform in the space environment. An overview of present and future detector requirements will be given together with the status of current array developments.

Author

*Imaging Techniques; Technology Utilization; Arrays*

**20020020451** Naval Postgraduate School, Monterey, CA USA

**Design, Implementation, and Testing of a High Performance Summation Adder for Radar Image Synthesis**

Amundson, Craig A.; Sep. 2001; 194p; In English; Original contains color images

Report No.(s): AD-A397237; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

This thesis documents the schematic design, simulation, and fabrication mask layout of a high-peed 16- bit summation adder to be integrated into the Digital Image Synthesizer (DIS) Application Specific Integrated Circuit (ASIC) . The DIS is a single-chip false target radar image generator to be used in countering wide band imaging radars. The DIS will calculate the false target image in 512 range bins. Each range bit utilizes two identical 16-bit binary adders. The 16-Bit Adder must compute the sum of two 16-bit numbers, providing a 16-bit sum, carry output, and overflow detection bit. The stated goal is for this adder to perform all of these functions in one pipeline stage while being clocked at 600 MHz. The first part of the design process includes an extensive analysis to utilize the fewest gates in designing the simplest adder that can achieve the 600 MHz goal. SPICE net lists are extracted from these schematic designs and simulations conducted to verify logic functionality and propagation speed. Mask layout of the verified

design is constructed using a CMOS 0.18 micron process utilizing deep sub-micron technology with six metal interconnect layers. The mask layout design is verified by ensuring all design rule checks (DRC) and layout versus schematic (LVS) checks are satisfied. In addition, conclusions and recommendations are provided to assist other DIS project members in using this adder and the aforementioned design process for additional components of the DIS ASIC.
DTIC
*Fabrication; Radar Imagery; Design Analysis; Imaging Techniques; Synthesizers; Performance Tests*

**20020020649** NASA Marshall Space Flight Center, Huntsville, AL USA
**A Daytime Aspect Camera for Balloon Altitudes**
Dietz, Kurt L., NASA Marshall Space Flight Center, USA; Ramsey, Brian D., NASA Marshall Space Flight Center, USA; Alexander, Cheryl D., NASA Marshall Space Flight Center, USA; Apple, Jeff A., NASA Marshall Space Flight Center, USA; Ghosh, Kajal K., Universities Space Research Association, USA; Swift, Wesley R., Raytheon Information Technology and Scientific Services, USA; [2001]; 2p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

We have designed, built, and flight-tested a new star camera for daytime guiding of pointed balloon-borne experiments at altitudes around 40km. The camera and lens are commercially available, off-the-shelf components, but require a custom-built baffle to reduce stray light, especially near the sunlit limb of the balloon. This new camera, which operates in the 600-1000 nm region of the spectrum, successfully provided daytime aspect information of approximately 10 arcsecond resolution for two distinct star fields near the galactic plane. The detected scattered-light backgrounds show good agreement with the Air Force MODTRAN models, but the daytime stellar magnitude limit was lower than expected due to dispersion of red light by the lens. Replacing the commercial lens with a custom-built lens should allow the system to track stars in any arbitrary area of the sky during the daytime.
Author
*Daytime; Cameras; Balloon-Borne Instruments; Star Trackers*

**20020020658** NASA Marshall Space Flight Center, Huntsville, AL USA
**Fractal Characterization of Multitemporal Remote Sensing Data, Chapter 1**
Quattrochi, Dale A., NASA Marshall Space Flight Center, USA; Emerson, Charles W., University of Western Michigan, USA; Lam, Nina Siu-Ngam, Louisiana State Univ., USA; Qiu, Hong-Lie, California State Univ., USA; Modeling Scale in Geographical Information Science; [2001], Chapter 1, pp. 13-34; In English; Copyright; Avail: Issuing Activity

Scale is an 'innate' concept in geographical information systems (GIS). It is recognized as something that is intrinsic to the capture, storage, manipulation, analysis, modelling, and output of space and time data within a GIS purview, yet the relative meaning and ramifications of scaling spatial and temporal data from this perspective remain enigmatic. As GIS becomes more sophisticated as a product of more robust software and more powerful computer systems, there is an urgent need to examine the issue of scale, and its relationship to the whole body of spatiotemporal data, as imparted in GIS. Scale is fundamental to the characterization of geo-spatial data as represented in GIS, but we have relatively little insight on how to measure the effects of scale in representing data that are acquired in different formats and exist in varying spatial, temporal and radiometric configurations. Moreover, the complexities associated with the integration of multi-scaled data sets in a multitude of formats are exacerbated by the confusion of what the term 'scale' means from a multidisciplinary perspective. 'Scale' takes on significantly different meanings depending upon one's disciplinary background and spatial perspective, which can lead to substantial confusion in the input, manipulation, analysis, and output operations. Hence, we must begin to look at the universality of scale and begin to develop the theory, methods and techniques necessary to advance knowledge on the 'Science of scale' across all disciplines that use GIS.
Derived from text
*Geographic Information Systems; Scale (Ratio); Fractals; Remote Sensing*

**20020020975** Naval Postgraduate School, Monterey, CA USA
**Radar Target Imaging Using Time-Reversed Processing**
Inaba, Yosuke; Sep. 2001; 102p; In English
Report No.(s): AD-A397112; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This thesis investigates and demonstrates the workability of the time-reversed process for radar imaging applications, particularly, for bi-static or multi-static radars. One benefit of the time-reversed process is its ability to reduce the calculation to determine the targets' shape. The finite-difference-time-domain (FDTD) method is used to demonstrate the time-reversed

process. Following an overview and description of the principles of the time-reversed process, the FDTD method is applied to the wave equation and the time reversed-process in 2-D space.
DTIC
*Finite Difference Time Domain Method; Radar Targets; Imaging Techniques*

**20020021240** NASA Langley Research Center, Hampton, VA USA
**Dot Projection Photogrammetric Technique for Shape Measurements of Aerospace Test Articles**
Jones, Thomas W., NASA Langley Research Center, USA; Pappa, Richard S., NASA Langley Research Center, USA; [2002]; 14p; In English; 40th AIAA Applied Aerodynamics Conference, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2002-0532; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Results from initial laboratory investigations with the dot projection photogrammetric technique are presented for three wind-tunnel test articles with a range of surface scattering and reflection properties. These test articles are a semispan model and a micro air vehicle with a latex wing that are both diffusely reflecting, and a highly polished specularly reflecting model used for high Reynolds number testing. Results using both white light and laser illumination are presented. Some of the advantages and limitations of the dot projection technique are discussed. Although a desirable final outcome of this research effort is the characterization of dynamic behavior, only static laboratory results are presented in this preliminary effort.
Author
*High Reynolds Number; Wind Tunnel Tests; Semispan Models; Wings*

## 36
## LASERS AND MASERS

*Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also 76 Solid-State Physics.*

**20020016213** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Superconducting RF Injector for High-Power Free Electron Lasers**
Bluem, H.; Todd, A. M. M.; Neil, G.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783612; JLAB-ACC-01-13; DOE/ER/40150-1865; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A key technology issue on the path to high-power FEL operation is the demonstration of reliable, high-brightness, photo-cathode injector operation. The physics and engineering conceptual design of a high-current superconducting RF injector has been completed and will be presented. The system, which is an outgrowth of the existing injector on the Jefferson Lab IRFEL(1), consists of an integrated room temperature DC photocathode gun and a 500 MHz superconducting RF accelerator. The device is compact and produces high-brightness beams. After DC acceleration in the gun, emittance compensation techniques are utilized to reduce the rms normalized emittance by over a factor of two to (approximately)2-1/4 mm-mrad at the output of the RF accelerator. The design is based upon the existing geometry of the Jefferson Lab DC gun and will be capable of operation at 100 mA average beam current.
NTIS
*Superconducting Devices; Free Electron Lasers; Superconductivity; Radio Frequencies; High Power Lasers*

**20020016358** Sandia National Labs., Albuquerque, NM USA
**Characterization of the Precision Laser Beam Welding Process for the MC4368A Neutron Generator**
Crowder, S. V.; Malizia, L. A.; Romero, J. A.; Sep. 01, 2001; 66p; In English
Report No.(s): DE2001-787636; SAND2001-2952; No Copyright; Avail: Department of Energy Information Bridge

The design of experiments (DOEx) approach was used to characterize the Precision Laser Beam Welding Process with respect to four processing factors: angle of attack, voltage, pulse length, and focus. The experiment was performed with lap joints, nickel-wire joints, and Kovar-wire joints. The laser welding process and these types of welds are used in the manufacture of MC4368A Neutron Generators. For each weld type an individual optimal condition and operating window was identified. The widths of the operating windows that were identified by experimentation indicate that the laser weld process is very robust. This is highly desirable because it means that the quality of the resulting welds is not sensitive to the exact values of the processing

factors within the operating windows. Statistical process control techniques can be used to ensure that the processing factors stay well within the operating window.
NTIS
*Experiment Design; Lap Joints; Laser Welding; Welded Joints*

**20020016694** Brookhaven National Lab., Upton, NY USA
**DUV-FEL development program**
Yu,; Dimauro,; Doyuran,; Graves,; Johnson,; Jun. 18, 2001; 5p; In English
Report No.(s): DE2001-783989; BNL-68466; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We discuss the design and output radiation parameters for the Deep Ultra-violet Free Electron Laser at BNL, which will generate coherent output down to 100 nm using High Gain Harmonic Generation. The result of FEL calculation and the status of the experiment are presented.
NTIS
*Free Electron Lasers; Extreme Ultraviolet Radiation*

**20020017399** Army Research Development and Standardization Group (UK), (united Kingdom) FPO New York 09510, FPO New York, NY USA
**LIBS 2000. International Conference (1st) on Laser Induced Plasma Spectroscopy and Applications Held in Tirrenia, Pisa (Italy) on 8-12 October 2000. Book of Abstracts**
Oct. 12, 2000; 152p; In English; The LIBS 2000 Conference is organized in collaboration with the Optical Society of America, European Optical Society, Societa Italiana di Fisica, Consiglio Nazionale delle Ricerche, Gruppo Nazionale de Struttura della Materia
Contract(s)/Grant(s): N68171-00-M-5883
Report No.(s): AD-A396924; R/D-8987-CH-02; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This document provides a number of abstracts related to laser induced plasma spectroscopy and applications.
CASI
*Plasmas (Physics); Laser Spectroscopy*

**20020017467** National Defence Research Establishment, Linkoeping, Sweden
**Laser Damage Evaluation Methods. Application to Critical Components in EO-Sensors**
Sjoeqvist, L.; Nov. 1999; 52p; In English
Report No.(s): PB2001-108485; FOA-R-99-01280-612-SE; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Electro-optical (EO) sensors employed in military applications are sensitive to laser exposure. Sensitive components include e.g. detectors or other components located in focal regions within the sensor. Studies of laser damage susceptibility must be performed, both experimentally and theoretically, to be able to define damage thresholds and explain damage mechanisms. One major problem in laser damage studies is to define the laser damage threshold and use appropriate methods to detect damage. Several parameters such as the experimental procedure, experimental parameters, damage evaluation methods and damage mechanisms may affect the damage threshold. The experimental procedures need to be designed carefully in order to determine accurate damage thresholds. The purpose of this report is to address the methodology used in laser damage measurements with emphasis on EO-sensors and related components. Methods used to analyze laser damage are reviewed. Different laser damage criteria are discussed. Important detector types, from a military point of view, and electrical parameters are considered. Some examples of the laser damage evaluation techniques used at FOA are presented.
NTIS
*Laser Damage; Detectors; Damage Assessment*

**20020019074** Lebedev Physical Inst., Chemical and Electric-discharge Laser Lab., Moscow, Russia
**Study of the Process of Mixing, Temperature, and Small Signal Gain in the Active Medium of Supersonic COIL With Advanced Nozzle Bank and DC Discharge Method of O2(Delta-1) Production in a Vortex Tube** ***Final Report, 10 Jan. 2000-23 Aug. 2001***
Nikolaev, Valeri; Jul. 2001; 81p; In English; Original contains color images
Report No.(s): AD-A396942; EOARD-ISTC 00-7016; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
This report results from a contract tasking P. N. Lebedev Physical Institute, as follows: The objective of this project is to develop the optimal ejector nozzle bank for chemical oxygen iodine laser and to diagnose the gain and gas dynamic characteristics

of the laser active medium employing the usual standard methods, laser induced fluorescence (LIF) and tunable one-mode semiconductor probe laser.
DTIC
*Semiconductor Lasers; Chemical Oxygen-Iodine Lasers; Dynamic Characteristics; Hilsch Tubes*

**20020020456** Air War Coll., Maxwell AFB, AL USA
**Laser Weapons in Space: A Critical Assessment**
Possel, William H.; Apr. 1998; 80p; In English
Report No.(s): AD-A397229; AU/AWC/197/1998-04; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Is the DOD pursuing the correct investment strategy for space-based high-energy lasers? Recent advances in lasers, optics, and spacecraft technologies may bring high-energy laser weapons to a sufficient level of maturity for serious consideration as space weapons against the theater ballistic missile threat. An important question is how these dramatic technology improvements have affected the strategic employment concepts for high-energy laser weapons. This study presents a comparison of competing space-based architectures given the progress made with high-energy lasers, large optics, and atmosphere compensation techniques within the past several years. Since the current Airborne Laser program utilizes only airborne assets, it is not part of this study. Three space-based architectures are evaluated against the ballistic missile threat: space-based lasers, ground-based lasers in conjunction with orbiting mirrors, and a combined approach using space-based lasers with orbiting mirrors. The evaluation criteria include the technology risks and the estimated development and deployment costs. Also, technology development programs are described for each of the architectures to address the high-risk areas. The results of this study suggest that the most technically sound and cost efficient architecture is space-based lasers with orbiting mirrors because this approach reduces the total weight and therefore cost on-orbit as well as the overall technical risks.
DTIC
*Laser Weapons; Airborne Lasers; Ballistic Missiles; Space Weapons*

## 37
## MECHANICAL ENGINEERING

*Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see 63 Cybernetics, Artificial Intelligence, and Robotics; and 54 Man/System Technology and Life Support.*

**20020016301** Concepts ETI, Inc., White River Jct, VT USA
**Design Study for a Low-Cost LH2 Turbopump**
Japikse, David, Concepts ETI, Inc., USA; Baines, Nicholas, Concepts ETI, Inc., USA; Platt, Michael J., Concepts ETI, Inc., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 13-22; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

A preliminary design study, focusing on potential component selections and design for manufacturing and assembly (DFMA) analysis, is presented in this study. The investigation focused on a nominal cost liquid hydrogen turbopump suitable for a private launch class vehicle. Utilizing a ”turbocharger-like” design philosophy, preliminary feasibility studies of the basic pump design class, the rotordynamic design class, and the turbine design class were conducted with associated DFMA evaluations. Reasonable cost levels and sensible levels of product assurance have been established.
Author
*Liquid Hydrogen; Manufacturing; Design Analysis; Turbomachinery; Low Cost*

**20020016657** Atomic Energy Commission, Idaho Falls, ID USA
**Field Operations Program: Neighborhood Electric Vehicle Fleet Use**
Francfort, J. E.; Carroll, M. R.; Jul. 02, 2001; 29p; In English
Report No.(s): DE2001-783887; INEEL/EXT-01-00864; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report summarizes a study of 15 automotive fleets that operate neighborhood electric vehicles (NEVs) in the USA. The information was obtained to help Field Operations Program personnel understand how NEVs are being used, how many miles they are being driven, and if they are being used to replace other types of fleet vehicles or as additions to fleets. (The Field Operations Program is a U.S. Department of Energy Program within the DOE Office of Energy Efficiency and Renewable Energy, Transportation Technologies). The NEVs contribution to petroleum avoidance and cleaner air can be estimated based on the miles

driven and by assuming gasoline use and air emissions values for the vehicles being replaced. Gasoline and emissions data for a Honda Civic are used as the Civic has the best fuel use for a gasoline-powered vehicle and very clean emissions. Based on these conservation assumptions, the 348 NEVs are being driven a total of about 1.2 million miles per year. This equates to an average of 3,409 miles per NEV annually or 9 miles per day. It is estimated that 29,195 gallons of petroleum use is avoided annually by the 348 NEVs. This equates to 87 gallons of petroleum use avoided per NEV, per year. Using the 348 NEVs avoids the generation of at least 775 pounds of smog-forming emissions annually.
NTIS
*Electric Motor Vehicles; Automobiles; Energy Conservation; Energy Technology*

**20020016721** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Development of a low swirl injector concept for gas turbines**
Cheng, R. K.; Fable, S. A.; Schmidt, D.; Arellano, L.; Smith, K. O.; Sep. 01, 2000; 7p; In English
Report No.(s): DE2001-785290; LBNL-47801; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This paper presents a demonstration of a novel lean premixed low-swirl injector (LSI) concept for ultra-low NOx gas turbines. Low-swirl flame stabilization method is a recent discovery that is being applied to atmospheric heating equipment. Low-swirl burners are simple and support ultra-lean premixed flames that are less susceptible to combustion instabilities than conventional high-swirl designs. As a first step towards transferring this method to turbines, an injector modeled after the design of atmospheric low-swirl burner has been tested up to T=646 F and 10 atm and shows good promise for future development.
NTIS
*Gas Turbines; Nitrogen Oxides; Injectors; Combustion*

**20020017754** NASA Marshall Space Flight Center, Huntsville, AL USA
**RP That's Right For You**
Cooper, Ken, NASA Marshall Space Flight Center, USA; [2001]; 10p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This article offers an unfiltered look at a large cross section of the different rapid prototyping technologies available today; from a guy with one of the biggest RP toy boxes in the world as the manager of the Rapid Prototyping Laboratory at NASA's Marshall Space Flight Center (MSFC) in Huntsville, AL, USA. NASA's current operation capacity is nine RP machines, representing eight actual technologies. The article presents a realistic, unbiased look at the technologies and offers advice on what to do and where to go for the best solution to your rapid prototyping needs.
Author
*Rapid Prototyping; Manufacturing; Software Engineering; Technologies*

**20020018151** Battelle Columbus Labs., OH USA
**Development of an Improved Method for Production of Torsion-Tube Springs for Tracked Vehicles** ***Final Report, 6 Jun. 1973-15 Mar. 1975***
Gegel, G. A.; Hoffmanner, A. L.; Siorek, R. W.; Mar. 1975; 91p; In English
Contract(s)/Grant(s): DAAE07-73-C-0235
Report No.(s): AD-A396862; TACOM-TR-12032; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The objectives of this manufacturing development program were to determine methods capable of producing torsion tubes at reduced manufacturing cost with no sacrifice in quality. The methods addressed was HYDRAFILM extrusion of tube blanks and final machining to configuration. It was found that the internal configuration can be brought to a near net condition as extruded thus precluding much I.D. machining. Failure of the extrusion tooling after 13 trials resulted in the final delivery of only four testable sample items. These were submitted for Government test and evaluation.
DTIC
*Manufacturing; Torsion; Tracked Vehicles; Machining*

**20020019841** Modern Technologies Corp., Propulsion Systems Group, Middleburg Heights, OH USA
**Exoskeletal Engine Concept: Feasibility Studies for Medium and Small Thrust Engines** ***Final Report***
Halliwell, Ian, Modern Technologies Corp., USA; November 2001; 132p; In English
Contract(s)/Grant(s): NAS3-27326; RTOP 714-01-10
Report No.(s): NASA/CR-2001-211322; NAS 1.26:211322; E-13132; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The exoskeletal engine concept is one in which the shafts and disks are eliminated and are replaced by rotating casings that support the blades in spanwise compression. Omission of the shafts and disks leads to an open channel at the engine centerline. This has immense potential for reduced jet noise and for the accomodation of an alternative form of thruster for use in a combined cycle. The use of ceramic composite materials has the potential for significantly reduced weight as well as higher working temperatures without cooling air. The exoskeletal configuration is also a natural stepping-stone to complete counter-rotating turbomachinery. Ultimately this will lead to reductions in weight, length, parts count and improved efficiency. The feasibility studies are in three parts. Part I-Systems and Component Requirements addressed the mechanical aspects of components from a functionality perspective. This effort laid the groundwork for preliminary design studies. Although important, it is not felt to be particularly original, and has therefore not been included in the current overview. Part 2-Preliminary Design Studies turned to some of the cycle and performance issues inherent in an exoskeletal configuration and some initial attempts at preliminary design of turbomachinery were described. Twin-spoon and single-spool 25.800-lbf-thrust turbofans were used as reference vehicles in a mid-size commercial subsonic category in addition to a single-spool 5,000-lbf-thrust turbofan that represented a general aviation application. The exoskeletal engine, with its open centerline, has tremendous potential for noise suppression and some preliminary analysis was done which began to quantify the benefits. Part 3-Additional Preliminary Design Studies revisited the design of single-spool 25,800-lbf-thrust turbofan configurations, but in addition to the original FPR = 1.6 and BPR = 5.1 reference engine, two additional configurations used FPR = 2.4 and BPR = 3.0 and FPR = 3.2 and BPR = 2.0 were investigated. The single-spool 5,000-lbf-thrust turbofan was refined and the small engine study was extended to include a 2,000-lbf-thrust turbojet. More attention was paid to optimizing the turbomachinery. Turbine cooling flows were eliminated, in keeping with the use of uncooled CMC material in exoskeletal engines. The turbine performance parameters moved much closer to the nominal target values, demonstrating the great benefits to the cycle of uncooled turbines.
Author

*Turbojet Engines; Feasibility; General Aviation Aircraft; Engine Design; Thrust; Turbofans*

**20020020168** NASA Marshall Space Flight Center, Huntsville, AL USA

**Survey of Advanced Booster Options for Potential Shuttle Derivative Vehicles**

Sackheim, Robert L., NASA Marshall Space Flight Center, USA; Ryan, Richard, NASA Marshall Space Flight Center, USA; Threet, Ed, NASA Marshall Space Flight Center, USA; [2001]; 17p; In English; 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference (JPC) and Exhibit, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A never-ending major goal for the Space Shuttle program is to continually improve flight safety, as long as this launch system remains in operational service. One of the options to improve system safety and to enhance vehicle performance as well, that has been seriously studied over the past several decades, is to replace the existing strap-on four segment solid rocket boosters (SRB's) with more capable units. A number of booster upgrade options have been studied in some detail, ranging from five segment solids through hybrids and a wide variety of liquid strap-ons (both pressure and pump fed with various propellants); all the way to a completely reusable liquid fly back booster (complete with air breathing engines for controlled landing and return). All of these possibilities appear to offer improvements in varying degrees; and each has their strengths and weaknesses from both programmatic and technical points of view. The most beneficial booster upgrade/design, if the shuttle program were to continue long enough to justify the required investment, would be an approach that greatly increased both vehicle and crew safety. This would be accomplished by increasing the minimum range/minimum altitude envelope that would readily allow abort to orbit (ATO), possibly even to zero/zero, and possibly reduce or eliminate the Return to Launch Site (RTLS) and even the Trans Atlantic Landing (TAL) abort mode requirements. This paper will briefly survey and discuss all of the various booster'upgrade options studied previously, and compare their relative attributes. The survey will explicitly discuss, in summary comparative form, options that include: five segment solids; several hybrid possibilities; pressure and/or pump-fed liquids using either LO2/kerosene, H2O/kerosene and LO2/J2, any of which could be either fully expendable, partly or fully reusable; and finally a fully reusable liquid fly back booster system, with a number of propellant and propulsion system options. Performance and configuration comparison illustrations and tables will be included to provide a comprehensive survey for the paper.
Author

*Booster Rocket Engines; Flight Safety; Air Breathing Engines; Space Shuttle Boosters; Solid Propellant Rocket Engines*

**20020020463** Wichita State Univ., Dept. of Mechanical Engineering, Wichita, KS USA

**Investigation of Adhesive Behavior in Aircraft Applications** ***Final Report***

Yang, Charles; Tomblin, John S.; Sep. 2001; 52p; In English

Report No.(s): AD-A397151; DOT/FAA/AR-01/57; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

There are two parts included in this report. The first part evaluates the most commonly used test method for adhesive properties, ADTM D 5656 'Standard Test Method for Thick-Adherend Metal Lap-Shear Joints for Determination of the Stress-Strain Behavior of Adhesives in Shear by Tension Loading'. Finite element analyses were conducted to simulate the specimen behavior following the ASTM procedures. It was found that deviations of the measured adhesive shear modulus from the true value can be as large as 20% if corrections are not made. Correction factors based on different bondline thicknesses and adhesive properties are provided in the report. There are generally three failure modes of adhesive-bonded composite joints: (1) adherend failure; (2) adhesive failure of the adhesive; and (3) cohesive failure of the adhesive. The second part of this report provides: (1) an analytical model for predicting stress distributions within an adhesive-bonded composite joint using ASTM D 3165 test specimen dimensions; and (2) a method for predicting joint strength under the adherend failure mode. The analytical model was verified using a finite element model and comparing the adhesive stress distributions of the two analyses. A failure analysis was conducted based on four failure criteria. Predicted strengths were compared with test data. It was shown that the maximum interlaminar axial tensile stress criteria predict the joint strength better than Tsai-Hill and von Mises criteria.
DTIC
*Adhesive Bonding; Adhesives; Failure; Failure Analysis; Stress-Strain Relationships*

## 38
## QUALITY ASSURANCE AND RELIABILITY

*Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.*

**20020016327** Pacific Northwest National Lab., Richland, WA USA
**Inspection of Solid Rocket Motors and Munitions using Ultrasonics**
Bond, L. J., Pacific Northwest National Lab., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 425-460; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Safe-life assessments for items in the U.S. munitions stockpile has traditionally focused on obtaining data through accelerated aging programs, employing periodic sampling, firing and destructive testing. to meet the new requirements for improved quality assurance and the development of predictive engineering/prognostics, remediation strategies for life extension and integrated system health monitoring with enhanced stockpile surveillance and life extension programs, the existing assessment techniques are being refined and new technologies and methodologies implemented. This paper discusses the history of applying ultrasonic evaluation techniques to polymers. It discusses the research on and applications of ultrasonic assessment techniques as they pertain to ordnance inspection, particularly of explosives, propellants, and solid-rocket motors. Developments during the last 20 years are reviewed. Four related evaluation technologies are examined: 1) advanced ultrasonic testing, now successfully implemented as a component of the Hydra-70 Quality Assurance program; the signal processing/inversion techniques of 2) impediography; 3) Born inversion; and 4) aging and damage assessment, using an ultrasonic evaluation technique applied to propellants and explosives. The scientific trend is to combine quantitative data derived from the ultrasonic evaluation techniques with that obtained from other nondestructive tests and also destructive testing. When coupled with high fidelity instrumentation and integrated as part of the life evaluation process, the data can then be incorporated with predictive life and degradation models. The result is an enhanced automated capability to assess the conditions of varied ordnance items. The adaptation and application of the science and technology developed for Quantitative Nondestructive Evaluation (QNDE), to munitions and ordnance items, within the framework of predictive engineering, can be expected to result in further improved reliability and safety, and has the potential to give significant cost avoidance.
Author
*Inspection; Solid Propellant Rocket Engines; Pyrotechnics; Polymers; Ammunition; Ultrasonic Tests*

**20020016686** Sandia National Labs., Albuquerque, NM USA
**Detection of Surface Contaminant Residue by Tunable Infrared Laser Imaging**
Ottesen, D.; Johnsen, H.; Allendorf, S.; Kulp, T.; Armstrong, K.; Jun. 01, 2001; 18p; In English
Report No.(s): DE2001-784198; SAND2001-8262; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We report the development of a new, real-time non-contacting monitor for cleaning verification based on tunable infrared-laser methods. New analytical capabilities are required to maximize the efficiency of cleaning operations at a variety of federal (Department of Defense (DoD) and Department of Energy (DOE)) and industrial facilities. These methods will lead to a reduction in the generation of waste streams while improving the quality of subsequent processes and the long-term reliability of manufactured, repaired or refurbished parts. We have demonstrated the feasibility of tunable infrared-laser imaging for the detection of contaminant residues common to DoD and DOE components. The approach relies on the technique of infrared

reflection spectroscopy for the detection of residues. An optical interface for the laser-imaging method was constructed, and a series of test surfaces was prepared with known amounts of contaminants. Independent calibration of the laser reflectance images was performed with Fourier transform infrared (FTIR) spectroscopy. The performance of both optical techniques was evaluated as a function of several variables, including the amount of contaminant, surface roughness of the panel, and the presence of possible interfering species (such as water). Finally, detection limits for generic hydrocarbon contaminants were evaluated as a function of system noise level.
NTIS
*Cleaning; Residues; Infrared Radiation; Contaminants*

**20020017477** Los Alamos National Lab., NM USA
**Advanced data processing for volumetric computed tomography data**
Sheats, M.; Aug. 01, 2001; 69p; In English
Report No.(s): DE2001-784592; LA-SUB-01-40; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Computed tomography (CT) has long been used by industry as a non-destructive evaluation technique for discovering flaws in parts before their use. Traditional linear array computed tomography systems acquired data at a rate that could be reconstructed simultaneously with data acquisition. With new area detectors, the data rate of acquisition has increased exponentially, and the reconstruction algorithm does not scale linearly with increased data. FlashCT DPS (Flat Panel Amorphous Silicon High Resolution Computed Tomography, Data Processing System) is a software package developed by M. Sheats, and A. Davis at LANL to meet the data processing demands of new flat panel array computed tomography. FlashCT - DPS combines several features unique to industrial computed tomography systems. It addresses traditional usability problems by providing an intuitive graphical user interface and powerful analysis tools. It includes the three major CT reconstruction algorithms: parallel backprojection, fan beam resorting, and Feldkamp cone beam. It also provides visualization tools for examination of data after processing. Finally, it is able to perform distributed data reconstruction with a near linear speed increase as a function of the number of processors used. Additionally, utility programs have been developed to support project editing and computing cluster management for the FlashCT system. FlashCT - DPS runs on a standard PC platform and operates well on a variety of processor and memory configurations.
NTIS
*Computer Aided Tomography; Data Processing; Nondestructive Tests*

**20020018161** NASA Marshall Space Flight Center, Huntsville, AL USA
**Thermal Analysis of the MC1 Engine Turbopump**
Roman, Jose, NASA Marshall Space Flight Center, USA; [2001]; 6p; In English; Thermal and Fluids Analysis Workshop (TFAWS) 2001, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
The MC1 Engine turbopump supplied the propellants to the main injector. The turbopump consisted of four parts; lox pump, interpropellant seal package (IPS), RP pump and turbine. The thermal analysis was divided into two 2D finite element models; Housing or stationary parts and rotor or rotating parts. Both models were analyzed at the same boundary conditions using SINDA. The housing model consisted of, lox pump housing, ips housing, RP housing, turbine inlet housing, turbine housing, exit guide vane, heat shield and both bearing outer races. The rotor model consisted of the lox impeller; lox end bearing and id race, RP impeller, and RP bearing and id race, shaft and turbine disk. The objectives of the analysis were to: (1) verified the original design and recommend modifications to it, (2) submitted a thermal environment to support the structural analysis, (3) support the component and engine test program. and (4) to support the X34 vehicle program.
Author
*Thermal Analysis; Two Dimensional Models; Engine Tests; Propellants; Finite Difference Theory; Boundary Conditions*

**20020018164** Thiokol Propulsion, Brigham City, UT USA
**Evaluation of a Linear Cumulative Damage Failure Model for Epoxy Adhesive**
Richardson, David E., Thiokol Propulsion, USA; Batista-Rodriquez, Alicia, Thiokol Propulsion, USA; Macon, David, Thiokol Propulsion, USA; Totman, Peter, Thiokol Propulsion, USA; [2001]; 8p; In English; AIAA Joint Propulsion Conference, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2001-6123; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche
Recently a significant amount of work has been conducted to provide more complex and accurate material models for use in the evaluation of adhesive bondlines. Some of this has been prompted by recent studies into the effects of residual stresses on the integrity of bondlines. Several techniques have been developed for the analysis of bondline residual stresses. Key to these

analyses is the criterion that is used for predicting failure. Residual stress loading of an adhesive bondline can occur over the life of the component. For many bonded systems, this can be several years. It is impractical to directly characterize failure of adhesive bondlines under a constant load for several years. Therefore, alternative approaches for predictions of bondline failures are required. In the past, cumulative damage failure models have been developed. These models have ranged from very simple to very complex. This paper documents the generation and evaluation of some of the most simple linear damage accumulation tensile failure models for an epoxy adhesive. This paper shows how several variations on the failure model were generated and presents an evaluation of the accuracy of these failure models in predicting creep failure of the adhesive. The paper shows that a simple failure model can be generated from short-term failure data for accurate predictions of long-term adhesive performance.
Author
*Evaluation; Linear Systems; Cumulative Damage; Failure; Adhesives*

**20020018894** Florida Agricultural and Mechanical Univ., Dept. of Mechanical Engineering, Tallahassee, FL USA
**Robust Fault Detection Using Robust Z1 Estimation and Fuzzy Logic**
Curry, Tramone, Florida Agricultural and Mechanical Univ., USA; Collins, Emmanuel G., Jr., Florida Agricultural and Mechanical Univ., USA; Selekwa, Majura, Florida Agricultural and Mechanical Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 21; In English; Also announced as 20020018881
Report No.(s): P13; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This research considers the application of robust Z(sub 1), estimation in conjunction with fuzzy logic to robust fault detection for an aircraft fight control system. It begins with the development of robust Z(sub 1) estimators based on multiplier theory and then develops a fixed threshold approach to fault detection (FD). It then considers the use of fuzzy logic for robust residual evaluation and FD. Due to modeling errors and unmeasurable disturbances, it is difficult to distinguish between the effects of an actual fault and those caused by uncertainty and disturbance. Hence, it is the aim of a robust FD system to be sensitive to faults while remaining insensitive to uncertainty and disturbances. While fixed thresholds only allow a decision on whether a fault has or has not occurred, it is more valuable to have the residual evaluation lead to a conclusion related to the degree of, or probability of, a fault. Fuzzy logic is a viable means of determining the degree of a fault and allows the introduction of human observations that may not be incorporated in the rigorous threshold theory. Hence, fuzzy logic can provide a more reliable and informative fault detection process. Using an aircraft flight control system, the results of FD using robust Z(sub 1) estimation with a fixed threshold are demonstrated. FD that combines robust Z(sub 1) estimation and fuzzy logic is also demonstrated. It is seen that combining the robust estimator with fuzzy logic proves to be advantageous in increasing the sensitivity to smaller faults while remaining insensitive to uncertainty and disturbances.
Author
*Fault Detection; Robustness (Mathematics); Fuzzy Systems; Flight Control*

**20020018915** Texas Univ., San Antonio, TX USA
**Reliability of a Series Pipe Network**
Harris, Rodney, Texas Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 42; In English; Also announced as 20020018881
Report No.(s): P34; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The goal of this NASA-funded research is to advance research and education objectives in theoretical and computational probabilistic structural analysis, reliability, and life prediction methods for improved aerospace and aircraft propulsion system components. Reliability methods are used to quantify response uncertainties due to inherent uncertainties in design variables. In this report, several reliability methods are applied to a series pipe network. The observed responses are the head delivered by a main pump and the line head at a desired flow rate. The probability that the flow rate in the line will be less than a specified minimum will be discussed.
Author
*Structural Analysis; Structural Reliability; Life (Durability); Propulsion System Configurations*

**20020018916** Texas Univ., San Antonio, TX USA
**Reliability of a Parallel Pipe Network**
Herrera, Edgar, Texas Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 43; In English; Also announced as 20020018881
Report No.(s): P35; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The goal of this NASA-funded research is to advance research and education objectives in theoretical and computational probabilistic structural analysis, reliability, and life prediction methods for improved aerospace and aircraft propulsion system

components. Reliability methods are used to quantify response uncertainties due to inherent uncertainties in design variables. In this report, several reliability methods are applied to a parallel pipe network. The observed responses are the head delivered by a main pump and the head values of two parallel lines at certain flow rates. The probability that the flow rates in the lines will be less than their specified minimums will be discussed.
Author
*Structural Analysis; Structural Reliability; Life (Durability); Propulsion System Configurations*

**20020019559** Northwestern Univ., Center for Quality Engineering and Failure Prevention, Evanston, IL USA
**Non-Contract Ultrasonic Diagnostic Systems** ***Final Report, 1 Aug. 2000-31 Jul. 2001***
Achenbach, Jan D.; Krishnaswamy, Sridhar; Nov. 2001; 19p; In English
Contract(s)/Grant(s): F49620-98-1-0285
Report No.(s): AD-A397006; AFRL-SR-BL-TR-01-0603; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this project was to develop advanced non-contract instrumentation for nondestructive detection and characterization of critical flaws in aircraft structures as part of a timely quantitative nondestructive evaluation (QNDE) program. In the past several years, we have successfully developed several advanced ultrasonics NDE (nondestructive evaluation) techniques that are relevant to the Air Force. This project was aimed at further development of advanced non-contact laser ultrasonic instrumentation for NDE so as to facilitate flaw detection and characterization. The sensing technique used is based on adaptive interferometry for non-contract detection of ultrasound. The generation of ultrasound is also by means of laser illumination. The advantages of using ultrasonic probe signals to interrogate the interiors of structures is well recognized. Non-contract laser ultrasonic NDE procedures, in addition: (1) provide increased speed of inspection; (2) are amenable to quantitative interpretation since they are independent of coupling efficiency; (3) can be used on complex structures with curved surfaces; (4) can be configured (using optical fibers for instance) into very compact systems that can be used for remote inspection of hard-to-reach areas such as the interiors of fuel tanks inside wing-boxes. The technical findings are outlined in this report. The project findings offer great promise for the realization of rapid multiplexed two-mixing interferometric receivers for laser ultrasonic detection of flaws in aircraft structures.
DTIC
*Interferometry; Ultrasonic Tests; Sound Detecting and Ranging; Aircraft Structures*

## 39
## STRUCTURAL MECHANICS

*Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.*

**20020016148** Academy of Sciences of the Ukraine, Kiev, Ukraine
**International Conference on Welded Structures Held in Kiev, Ukraine on October 2000. Abstracts of Poster Papers** ***Final Report***
Oct. 2000; 167p; In English
Report No.(s): AD-A396770; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This volume contains abstracts in Russian with their English translations for papers presented at the International Conference on 'Welded Structures' held in Kiev, Ukraine in October 2000. Conference session topics include: strength of welded joints; quality control, technical diagnostics and evaluation of residual life of welded structures; technologies, equipment and materials for welding, surfacing, brazing, cutting and coating; and, certification of products of welding industry and attestation of specialists.
DTIC
*Welding; Welded Joints; Welded Structures; Certification*

**20020016156** Academy of Sciences of the Ukraine, Kiev, Ukraine
**International Conference on Welded Structures Held in Kiev, Ukraine on October 10-12, 2000. Papers of Plenary Sessions**
Paton, B. E.; Jan. 2001; 177p; In English
Report No.(s): AD-A396753; ISSN 0957-798X; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Conference papers discuss new types of welded structures, applications of advanced structural materials, optimization of structures, automated computation and design methods, theoretical and experimental studies of stress-strain states, methods for improving reliability and extending service life and more.
DTIC
*Welded Structures; Stress-Strain Relationships; Automatic Control*

**20020016387** Sandia National Labs., Albuquerque, NM USA
**Proposed Extension of FETI Methods to the Boundary Element Technique**
Griffith, R. O.; Murata, K. K.; Oct. 01, 2001; 35p; In English
Report No.(s): DE2001-787646; SAND2001-3140; No Copyright; Avail: Department of Energy Information Bridge
One emerging threat to the national critical infrastructure is the release of chemical or biological agents in or near large complex facilities. Predictive computational models for the time-dependent transport of gas and aerosol in and around target facilities is required to effectively assess and mitigate this threat. Despite this growing need for computational flow models that can be used in extremely large, complex geometries, current computational approaches are limited to 10(exp 7) to 10(exp 8) nodes. This is sufficient to model a single large interior space with a typical level of turbulence, but far less than the number of computation cells required to model all or even part of a large, modern building. The use of non-overlapping finite-element domain decomposition methods to achieve scalability with respect to problem size on massively parallel computers has been extensively developed over the past decade. In some cases, a high degree of scalability is achieved with only a single level of domain decomposition. Since a single level of domain decomposition is desirable for load balancing on massively parallel computers, a single-level method has the advantage of not introducing additional complex substructures on the problem, although special requirements may be imposed by the domain decomposition method on the nature of the subdomains to preserve scalability.
NTIS
*Decomposition; Finite Element Method; Gas Transport; Mathematical Models; Boundary Element Method*

**20020016700** Fermi National Accelerator Lab., Batavia, IL USA
**Quenches and resulting thermal and mechanical effects on epoxy impregnated Nb3Sn high field magnets**
Yamada, R.; Aug. 03, 2001; 3p; In English
Report No.(s): DE2001-783971; FERMILAB-CONF-01/146-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Thermal and its resulting mechanical stress due to quenches inside the Epoxy impregnated Nb3Sn high field magnets are studied with a combination of a quench simulation program, and ANSYS program. We use the geometry of the high field cosine theta type dipole magnets with one meter and 10 meter length. The turns, where quenches started, are excessively heated up, up to 100 K to 300 K, depending on the coil length and time delay. The non quenching turns and surrounding material are not heated substantially. This elevated temperature and its gradient cause the excessive local stress in the quenching conductors and their insulation material. The stress and strain in the conductor as well as in the insulation become excessive, and they are studied using the ANSYS stress analysis.
NTIS
*Niobium Stannides; High Field Magnets; Quenching (Atomic Physics)*

**20020017457** Joint Inst. for the Advancement of Flight Sciences, Hampton, VA USA
**Pathfinder Photogrammetry Research for Ultra-Lightweight and Inflatable Space Structures**
Giersch, Louis Roy Miller, Joint Inst. for the Advancement of Flight Sciences, USA; November 2001; 78p; In English
Contract(s)/Grant(s): NCC1-01017; RTOP 755-06-00-03
Report No.(s): NASA/CR-2001-211244; NAS 1.26:211244; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The defining characteristic of ultra-lightweight and inflatable space structures is that they are both very large and very low mass. This makes standard contacting methods of measurement (e.g. attaching accelerometers) impractical because the dynamics of the structure would be changed by the mass of the contacting instrument. Optical measurements are therefore more appropriate. Photogrammetry is a leading candidate for the optical analysis of gossamer structures because it allows for the measurement of a large number of points, is amenable to time sequences, and offers the potential for a high degree of accuracy. The purpose of this thesis is to develop the methodology and determine the effectiveness of a photogrammetry system in measuring ultra-lightweight and inflatable space structures. The results of this thesis will be considered in the design of an automated photogrammetry system for the l6m-diameter vacuum chamber at the NASA Langley Research Center.
Author
*Photogrammetry; Inflatable Space Structures; Optical Measurement; Structural Analysis*

**20020017578** NASA Langley Research Center, Hampton, VA USA

**Improving Metallic Thermal Protection System Hypervelocity Impact Resistance Through Design of Experiments Approach**

Poteet, Carl C., NASA Langley Research Center, USA; Blosser, Max L., NASA Langley Research Center, USA; [2002]; 22p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0912; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A design of experiments approach has been implemented using computational hypervelocity impact simulations to determine the most effective place to add mass to an existing metallic Thermal Protection System (TPS) to improve hypervelocity impact protection. Simulations were performed using axisymmetric models in CTH, a shock-physics code developed by Sandia National Laboratories, and validated by comparison with existing test data. The axisymmetric models were then used in a statistical sensitivity analysis to determine the influence of five design parameters on degree of hypervelocity particle dispersion. Several damage metrics were identified and evaluated. Damage metrics related to the extent of substructure damage were seen to produce misleading results, however damage metrics related to the degree of dispersion of the hypervelocity particle produced results that corresponded to physical intuition. Based on analysis of variance results it was concluded that the most effective way to increase hypervelocity impact resistance is to increase the thickness of the outer foil layer. Increasing the spacing between the outer surface and the substructure is also very effective at increasing dispersion.

Author

*Analysis of Variance; Design Analysis; Hypervelocity Impact; Impact Resistance; Computerized Simulation; Mass Distribution*

**20020018625** Building and Construction Research TNO, Centre for Maritime Engineering, Delft, Netherlands

**Shock Testing of a Cabinet with MSA Air Bottles**

Bosman, B., Building and Construction Research TNO, Netherlands; Jul. 01, 2001; 72p; In English; Original contains color illustrations

Contract(s)/Grant(s): A99/KM/102; TNO Proj. 006.03523/01.01

Report No.(s): TD-2001-15; TNO-2001-CMC-R047; Copyright; Avail: Issuing Activity

On behalf of the Royal Netherlands Navy a cabinet with MSA air bottles has been shock tested at shock grade D level H and shock grade C level H conform the shock specifications LCF. Minor mechanical damage has been ascertained during the shock tests. The cabinet with MSA air bottles satisfies the given shock requirements.

Author

*Bottles; Impact Damage; Shock Tests; Panels*

## 42
## GEOSCIENCES (GENERAL)

*Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see categories 41 through 48.*

**20020016086** Hawaii Univ., Hawaii Inst. of Geophysics and Planetology, Honolulu, HI USA

**Measurements of Aerosol, Ocean and Sky Properties at the HOT Site in the Central Pacific, Chapter 20**

Porter, John N., Hawaii Univ., USA; Letelier, Ricardo, Hawaii Univ., USA; SIMBIOS Project; January 2001, pp. 140-145; In English; Also announced as 20020016067

Contract(s)/Grant(s): NAS5-97136; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Monthly cruises have been made to the HOT site (approximately 100 km north of Oahu) since October 1988. The goal of these cruises is to make hydrography, chemistry, and biology observations. Measurements are typically made at a near coastal station (Kahe) on the first day to test the equipment and to obtain coastal shallow water (approximately 1500 m) observations. The second and third days are spent at the HOT site. On the morning of the fourth day, measurements are made at the HOT site and noontime measurements are made at the Hale-Aloha station near the mooring before returning to port by early the next morning. The locations of the three stations are Kahe, HOT, and Hale-ALOHA buoy. The routine HOT measurements are available during the summer following the year of the observations. The 1998 measurements will therefore become available during the summer of 1999. The data sets can be obtained at the National Oceanographic Data Center (NODC) or from the HOT web site http://kahana.soest.hawaii.edu/hot/hot_jgofs.html.

Author

*Aerosols; Coastal Water; Oceanographic Parameters; In Situ Measurement*

**20020016103** Bonneville Power Administration, Portland, OR USA

**Smolt monitoring at the head of Lower Granite Reservoir and Lower Granite Dam, 1998**

Apr. 01, 2000; 81p; In English

Report No.(s): DE2001-787363; DOE/BP-11631-14; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This project monitored the daily passage of chinook salmon Oncorhynchus tshawytscha, steelhead trout O. mykiss, and sockeye salmon smolts O. nerka, during the 1998 spring outmigration at migrant traps on the Snake and Salmon rivers. All hatchery chinook salmon released above Lower Granite Dam 19 1998 were marked with a fin-clip. Total annual hatchery chinook salmon catch at the Snake River trap was 226% of the 1997 number and 110% of the 1996 catch. The wild chinook catch was 120% of the 1997 catch but was only 93% of 1996. Hatchery steelhead trout catch was 501% of 1997 numbers but only 90% of the 1996 numbers. Wild steelhead trout catch was 569% of 1997 and 125% of the 1996 numbers. The Snake River trap collected 106 age-0 chinook salmon. During 1998, for the first time, the Snake River trap captured a significant number of hatchery sockeye salmon (1,552) and hatchery coho salmon O. kisutch (166). Differences in trap catch between years are due to fluctuations not only in smolt production, but also differences in trap efficiency and duration of trap operation associated with high flows. Trap operations began on March 8 and were terminated for the season due to high flows on June 12. The trap was out of operation for 34 d during the season due to high flow and debris. Hatchery chinook salmon catch at the Salmon River trap was 476% and wild chinook salmon catch was 137% of 1997 numbers and 175% and 82% of 1996 catch, respectively. The hatchery steelhead trout collection in 1998 was 96% of the 1997 catch and 13% of the 1996 numbers. Wild steelhead trout collection in 1998 was 170% of the 1997 catch and 37% of the 1996 numbers. Travel time (d) and migration rate (km/d) through Lower Granite Reservoir for PIT-tagged chinook salmon and steelhead trout, marked at the head of the reservoir were affected by discharge. For fish tagged at the Snake River trap, statistical analysis of 1998 detected a significant relation between migration rate and discharge. For hatchery and wild chinook salmon there was a 2.0- and 2.6-fold increase in migration rate, respectively, between 50 and 100 thousands of cubic feet per second (kcfs). For hatchery steelhead trout there was a 2.6-fold increase in migration rate between 50 kcfs and 100 kcfs. For fish marked at the Salmon River trap, statistical analysis of the 1998 data detected a significant relation between migration rate and discharge for hatchery and wild chinook salmon hatchery and found a 3.3- and 2.6-fold increase in migration rate, respectively, between 50 and 100 kcfs. A significant relation between migration rate and discharge was not detected for hatchery steelhead trout. Insufficient numbers of wild steelhead trout were PIT-tagged at the Salmon River trap to estimate travel time and migration rate to Lower Granite Dam.

NTIS

*Dams; Fishes; Granite; Reservoirs; Statistical Analysis*

**20020016134** North Carolina State Univ., Raleigh, NC USA

**Pine Gene Discovery Project - Final Report - 08/31/1997 - 02/28/2001**

Whetten, R. W.; Sederoff, R. R.; Kinlaw, C.; Retzel, E.; Apr. 30, 2001; 15p; In English

Report No.(s): DE2001-787343; DOE/ID/13550; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Integration of pines into the large scope of plant biology research depends on study of pines in parallel with study of annual plants, and on availability of research materials from pine to plant biologists interested in comparing pine with annual plant systems. The objectives of the Pine Gene Discovery Project were to obtain 10,000 partial DNA sequences of genes expressed in loblolly pine, to determine which of those pine genes were similar to known genes from other organisms, and to make the DNA sequences and isolated pine genes available to plant researchers to stimulate integration of pines into the wider scope of plant biology research. Those objectives have been completed, and the results are available to the public. Requests for pine genes have been received from a number of laboratories that would otherwise not have included pine in their research, indicating that progress is being made toward the goal of integrating pine research into the larger molecular biology research community.

NTIS

*Genes; Molecular Biology; Plants (Botany); Deoxyribonucleic Acid*

**20020016238** Oak Ridge Y-12 Plant, TN USA

**Groundwater Protection Program Management Plan for the U.S. Department of Energy Y-12 National Security Complex, Oak Ridge, Tennessee**

Jun. 01, 2001; 45p; In English

Report No.(s): DE2001-787059; Y/SUB/01-006512/2; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This document presents the Groundwater Protection Program (GWPP) management plan for the U.S. Department of Energy (DOE) Y-12 National Security Complex (hereafter referenced as Y-12). The Y-12 GWPP functions as the primary point-of-contact

for groundwater-related issues at Y-12, provides stewardship of the extensive network of groundwater monitoring wells at Y-12, and serves as a resource for technical expertise, support, and historical data for groundwater-related activities at Y-12.
NTIS
*Management; Ground Water; Management Planning; Protection*

**20020016245** California Univ., Berkeley, CA USA
**Geophysics with applications to subsurface waste disposal: Case history**
Lee, K. H.; Aug. 09, 2001; 21p; In English
Report No.(s): DE2001-787164; LBNL-48776; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Recent development in geophysical methods allows us to accurately map the distribution of seismic velocity, density and electrical conductivity beneath the surface and between boreholes. These physical properties are dependent on porosity, fluid saturation, fluid conductivity, pressure, temperature, clay content, and in some circumstances, permeability. Hydrological parameters may be measured or inferred from drill hole experiments or directly from core samples. The point measurements in a drill hole are then interpolated to the interwell volume using either statistical properties of the local geology or reasonable estimates of the geological structure and lithology. More direct evidence is obtained from well tests, and interference tests between multiple wells, but these are ill posed inverse problems when it comes to defining the properties of the entire interwell volume. Furthermore such tests are impossible in the vadose zone. The interpolation of well data is often inaccurate or misleading and the central problem for all these studies is the lack of these fundamental parameters throughout the subsurface volume of interest.
NTIS
*Waste Disposal; Geophysics; Radioactive Wastes; Underground Structures*

**20020016293** IT Corp., Las Vegas, NV USA
**Corrective Action Investigation Plan for Corrective Action Unit 97: Yucca Flat/Climax Mine, Nevada Test Site, Nevada (Revision 0, September 2000)**
Sep. 27, 2000; 381p; In English
Report No.(s): DE2001-787385; DOE/NV-659; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This Corrective Action Investigation Plan contains the U.S. Department of Energy, Nevada Operations Office's (DOE/NV's) approach to collect the data necessary to evaluate Corrective Action Alternatives (CAAs) appropriate for the closure of Corrective Action Unit (CAU) 97 under the Federal Facility Agreement and Consent Order (FFACO). Corrective Action Unit 97, collectively known as the Yucca Flat/Climax Mine CAU, consists of 720 Corrective Action Sites (CASs). The Yucca Flat/Climax Mine CAU extends over several areas of the NTS and constitutes one of several areas used for underground nuclear testing in the past. The nuclear tests resulted in groundwater contamination in the vicinity as well as downgradient of the underground test areas. Based on site history, the Yucca Flat underground nuclear tests were conducted in alluvial, volcanic, and carbonate rocks; whereas, the Climax Mine tests were conducted in an igneous intrusion located in northern Yucca Flat. Particle-tracking simulations performed during the regional evaluation indicate that the local Climax Mine groundwater flow system merges into the much larger Yucca Flat groundwater flow systems during the 1,000-year time period of interest. Addressing these two areas jointly and simultaneously investigating them as a combined CAU has been determined the best way to proceed with corrective action investigation (CAI) activities. The purpose and scope of the CAI includes characterization activities and model development conducted in five major sequential steps designed to be consistent with FFACO Underground Test Area Project's strategy to predict the location of the contaminant boundary, develop and implement a corrective action, and close each CAU. The results of this field investigation will support a defensible evaluation of CAAs in the subsequent corrective action decision document.
NTIS
*Mines (Excavations); Contamination; Ground Water; Energy Technology; Igneous Rocks*

**20020016384** Oak Ridge Y-12 Plant, TN USA
**Quarterly Progress Report: Biological Monitoring Program for East Fork Poplar Creek, January 19, 2001**
Adams, S. M.; Christensen, S. W.; Greeley, M. S.; McCracken, M. K.; Peterson, M. J.; Jan. 19, 2001; 22p; In English
Report No.(s): DE2001-784627; Y/TS-1194/33; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
In May 1985, a National Pollutant Discharge Elimination System (NPDES) permit was issued for the Oak Ridge Y-12 National Security Complex (formerly the Oak Ridge Y-12 Plant). As a condition of the permit, a Biological Monitoring and Abatement Program (BMAP) was developed to demonstrate that the effluent limitations established for the Y-12 Complex protect the classified uses of the receiving stream (East Fork Poplar Creek; EFPC), in particular, the growth and propagation of aquatic life (Loar et al. 1989). A second objective of the BMAP is to document the ecological effects resulting from the implementation of a water pollution control program designed to eliminate direct discharges of wastewaters to EFPC and to minimize the

inadvertent release of pollutants to the environment. Because of the complex nature of the discharges to EFPC and the temporal and spatial variability in the composition of the discharges, a comprehensive, integrated approach to biological monitoring was developed. A new permit was issued to the Y-12 Complex on April 28, 1995 and became effective on July 1, 1995. Biological monitoring continues to be required under the new permit. The BMAP consists of four major tasks that reflect different but complementary approaches to evaluating the effects of the Y-12 Complex discharges on the aquatic integrity of EFPC. These tasks are (1) toxicity monitoring, (2) biological indicator studies, (3) bioaccumulation studies, and (4) ecological surveys of the periphyton, benthic macroinvertebrate, and fish communities. Monitoring is currently being conducted at five primary EFPC sites, although sites may be excluded or added depending upon the specific objectives of the various tasks. Criteria used in selecting the sites include: (1) location of sampling sites used in other studies, (2) known or suspected sources of downstream impacts, (3) proximity to U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) boundaries, (4) concentration of mercury in the adjacent floodplain, (5) appropriate habitat distribution, and (6) access. The primary sampling sites include upper EFPC at kilometers (EFKs) 24.4 and 23.4 (upstream and downstream of Lake Reality (LR) respectively); EFK 18.7 (also EFK 18 and 19), located off the ORR and below an area of intensive commercial and light industrial development; EFK 13.8 (also EFK 14), located upstream from the Oak Ridge Wastewater Treatment Facility (ORWTF); and EFK 6.3 located approximately 1.4 km below the ORR boundary (Fig. 1.1). Brushy Fork (BF) at kilometer (BFK) 7.6 is used as a reference stream in most tasks of the BMAP. Additional sites off the ORR are also occasionally used for reference, including Beaver Creek, Bull Run, Hinds Creek, Paint Rock Creek, and the Emory River in Watts Bar Reservoir (Fig. 1.2).
NTIS
*Contaminants; Flood Plains; Marine Biology*

**20020016388** Argonne National Lab., IL USA
**Atmospheric Radiation Measurement Program facilities newsletter, June 2001**
Holdridge, D. J.; Jul. 10, 2001; 2p; In English
Report No.(s): DE2001-783639; ANL/ER/NL-01-06; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The ARM Program studies clouds, sunlight, and their interactions to understand how they affect Earth's climate. One of the many instruments used to look at clouds at the SGP CART site is the micropulse lidar (MPL; "lidar" was coined from "light distance and ranging"). The ARM Program operates five MPLs. One is at the SGP central facility; one is at the North Slope of Alaska CART site in Barrow, Alaska; and three are for use at the Tropical Western Pacific site on Nauru and Manus islands. The MPL is a remote sensing instrument used to measure the height of overhead clouds and particles. An eye-safe laser in the system directs a beam vertically. As short pulses of laser light travel through the sky, they may encounter water droplets or aerosol particles in the atmosphere. These particles intercept the laser light and scatter it in different directions. Some of the scattered light returns to Earth's surface. A receiver on the ground collects backscattered light that bounces off atmospheric particles and uses the information to determine the distance between the ground and the particles. The signals detected are collected and plotted. The greater the signal strength, the more scatterers are present in the atmosphere. A plot based on this relationship provides a "snapshot" of the cloud overhead and shows the structure inside the cloud. In addition, the information gathered from the MPL can be used to determine the height of the planetary boundary layer, the well-mixed layer of the atmosphere that develops during daytime hours as the sun heats Earth's surface and sets up vertical mixing. Small airborne particles that can also be detected include smoke or dust carried into the atmosphere. This information is valuable to climate researchers. Because the MPL uses an eye-safe laser, it is not a danger to pilots of planes flying overhead and can be run continuously. The availability of continuous data is a great benefit to researchers in their efforts to incorporate the interactions of clouds and solar radiation into climate models. Another strength of the MPL is long-range detection. The MPL can detect clouds at altitudes above six miles and stratospheric aerosols as high as nine miles.
NTIS
*Atmospheric Radiation; Radiation Measurement; Micropulsations; Optical Radar*

**20020018187** Oak Ridge National Lab., TN USA
**Geographical Distribution of Biomass Carbon in Tropical Southeast Asian Forests: A Database**
Brown, S.; May 22, 2001; 78p; In English
Report No.(s): DE2001-787535; ORNL/CDIAC-119; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A database was generated of estimates of geographically referenced carbon densities of forest vegetation in tropical Southeast Asia for 1980. A geographic information system (GIS) was used to incorporate spatial databases of climatic, edaphic, and geomorphological indices and vegetation to estimate potential (i.e., in the absence of human intervention and natural disturbance)

carbon densities of forests. The resulting map was then modified to estimate actual 1980 carbon density as a function of population density and climatic zone. The database covers the following 13 countries: Bangladesh, Brunei, Cambodia (Campuchea), India, Indonesia, Laos, Malaysia, Myanmar (Burma), Nepal, the Philippines, SRi Lanka, Thailand, and Vietnam. The data sets within this database are provided in three file formats: ARC/INFO(trademark) exported integer grids, ASCII (American Standard Code for Information Interchange) files formatted for raster-based GIS software packages, and generic ASCII files with x, y coordinates for use with non-GIS software packages.
NTIS
*Biomass; Carbon; Forests*

**20020018865** Geological Survey, Water Resources Div., Sacramento, CA USA
**Numerical Simulation of Ground-Water Flow and Land Subsidence at Edwards Air Force Base, Antelope Valley, California**
Nishikawa, T.; Rewis, D. L.; Martin, P.; 2001; 124p; In English
Report No.(s): PB2001-108188; USGS/WRI-01-4038; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Edwards Air Force Base (EAFB) in southern California historically has relied on ground water for its water-supply needs. Pumping of groundwater at the base has led to problems such as declining water levels and land subsidence. For this study, a MODFLOW-based ground-water flow model was developed for EAFB to estimate the effects of pumping and injection strategies on water levels and on land subsidence.
NTIS
*Ground Water; Hydrology Models; Subsidence; Computerized Simulation*

**20020020650** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Electronic-Theater 2001: Visions of Our Planet's Atmosphere, Land and Oceans**
Hasler, Authur, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; AMS Satellite Conference, 16-17 Oct. 2001, Madison, WI, USA; Sponsored by American Meteorological Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only
The NASA/NOAA/AMS Electronic Theater presents Earth science observations and visualizations in a historical perspective. Fly in from outer space to Wisconsin, Madison and the Monona Terrace Center. Drop in on the Kennedy Space Center and Park City Utah, site of the 2002 Olympics using I m IKONOS "Spy Satellite" data. Go back to the early weather satellite images from the 1960s pioneered by UW. Scientists and see them contrasted with the latest US and International global satellite weather movies including hurricanes & tornadoes. See the latest spectacular images from NASA/NOAA remote sensing missions like Terra GOES, TRMM, SeaWiFS, LANDSAT 7 that are visualized & explained. See how High Definition Television (HDTV) is revolutionizing the way we communicate science in cooperation with the American Museum of Natural History in NYC. See dust storms in Africa and smoke plumes from fires in Mexico. See visualizations featured on Newsweek, TIME, National Geographic, Popular Science covers & National & International Network TV. New visualization tools allow us to roam & zoom through massive global images eg LANDSAT tours of the US, Africa, & New Zealand showing desert and mountain geology as well as seasonal changes in vegetation. See animations of the polar ice packs and the motion of gigantic Antarctic Icebergs from SeaWinds data. Spectacular new visualizations of the global atmosphere & oceans are shown. See massive dust storms sweeping across Africa. See vortices and currents in the global oceans that bring up the nutrients to feed tiny plankton and draw the fish, whales and fisherman. See the how the ocean blooms in response to these currents and El Nina/La Nina climate changes. The demonstration is interactively driven by a SGI Onyx 11 Graphics Supercomputer with four CPUs, 8 Gigabytes of RAM and Terabyte of disk. With five projectors on a giant IMAX sized 18 x 72 ft screen. See the city lights, fishing fleets, gas flares and bio-mass burning of the Earth at night observed by the "nightvision" DMSP military satellite.
Author
*High Definition Television; Earth Sciences; Earth Observations (From Space); Satellite Imagery*

**20020020734** NASA Goddard Space Flight Center, Greenbelt, MD USA
**2002 Blue Marble and Developments in HDTV Technology for Public Outreach**
Hasler, Fritz, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; 11th Conference on Satellite Meteorology and Oceanography, 15-18 Oct. 2001, Madison, WI, USA; No Copyright; Avail: Issuing Activity; Abstract Only
Fritz Hasler (NASA/Goddard) will demonstrate the latest Blue Marble Digital Earth technology. We will fly in from space through Terra, LANDSAT 7, to 1 m Ikonos "Spy Satellite" data of Disney World and the Orlando Convention Center. You will see the complete global cloud free and cloudy 500 m datasets from the EOS Terra satellite. Spectacular new animations from Terra, LANDSAT 7, and SeaWiFS will be presented. See also animations of the hurricanes & tropical storms of the 2001 season, as well as Floyd, Georges, and Mitch, etc. from GOES & TRMM supported by MM5 3-D nested numerical model results. See movies

assembled using new low cost HDTV nonlinear editing equipment that is revolutionizing the way we communicate scientific results. See climate change in action with Global Land & Ocean productivity changes over the last 20 years. Remote sensing observations of ocean SST, height, winds, color, and El Nino from GOES, AVHRR, SSMI & SeaWiFS are put in context with atmospheric and ocean simulations. Compare symmetrical equatorial eddies observed by GOES with the simulations.
Author
*High Definition Television; Terra Spacecraft; LANDSAT 7; Sea-Viewing Wide Field-Of-View Sensor*

## 43
## EARTH RESOURCES AND REMOTE SENSING

*Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see 35 Instrumentation and Photography.*

**20020016193** California Univ., Berkeley, CA USA
**Use of INSAR in surveillance and control of a large field project**
Patzek, T. W.; Silin, D. B.; Jun. 01, 2000; 12p; In English
Report No.(s): DE2001-787150; LBNL--48544; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this paper, we introduce a new element of our multilevel, integrated surveillance and control system; satellite Synthetic Aperture Radar interferometry (InSAR) images of oil field surface. In particular, we analyze five differential InSAR images of the Belridge Diatomite field, CA, between 11/98 and 12/99. The images have been reprocessed and normalized to obtain the ground surface displacement rate. In return, we have been able to calculate pixel the net subsidence of ground surface over the entire field area. The calculated annual subsidence volume of 19 million barrels is thought to be close to the subsidence at the top of the diatomite. We have also compared the 1999 rate of surface displacement from the satellite images with the surface monument triangulations between 1942 and 1997. We have found that the maximum rate of surface subsidence has been steadily increasing from -0.8 ft/year in 1988-97 to -1 ft/year in 1998-99. The respective rates of uplift of the field fringes also increased from 0.1 ft/year to 0.24 ft/year. In 1999, the observed subsidence rate exceeded by 4.5 million barrels the volumetric deficit of fluid injection.
NTIS
*Remote Sensing; Surveillance; Water Circulation; Synthetic Aperture Radar; Satellite Imagery*

**20020017230** NASA Goddard Space Flight Center, Greenbelt, MD USA
**AESMIR: A New NASA Airborne Microwave Imager**
Kim, Edward J., NASA Goddard Space Flight Center, USA; Hood, Robbie, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Specialist Meeting on Microwave Remote Sensing, 5-9 Nov. 2001, Boulder, CO, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Airborne Earth Science Microwave Imaging Radiometer (AESMIR) is a versatile new airborne imaging radiometer under development by NASA. The AESMIR design is unique in that it will perform dual-polarized imaging at all AMSR frequency bands (6.9 through 89 GHz) using only one sensor head/scanner package, providing an efficient solution for AMSR-type science applications (snow, soil moisture/land parameters, precip, ocean winds, SST, water vapor, sea ice, etc.). The microwave radiometers themselves will incorporate state-of-the-art receivers, with particular attention given to instrument calibration for the best possible accuracy and sensitivity. The single-package design of AESMIR makes it compatible with high-altitude aircraft platforms such as the NASA ER-2s and the Proteus. The arbitrary 2-axis gimbal can perform conical and cross-track scanning, as well as fixed-beam staring. This compatibility with high-altitude platforms coupled with the flexible scanning configuration, opens up previously unavailable science opportunities for convection/precip/cloud science and co-flying with complementary instruments, as well as providing wider swath coverage for all science applications. by designing AESMIR to be compatible with these high-altitude platforms, we are also compatible with the NASA P-3, the NASA DC-8, and ground-based deployments. Thus AESMIR can provide low-, mid-, and high altitude microwave imaging.
Author
*Airborne Equipment; Earth Sciences; Imaging Techniques; Microwave Radiometers; NASA Space Programs; Flying Platforms*

**20020017523** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Microwave Remote Sensing and the Cold Land Processes Field Experiment**
Kim, Edward J., NASA Goddard Space Flight Center, USA; Cline, Don, NASA Goddard Space Flight Center, USA; Davis, Bert,

NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Specialist Meeting on Microwave Remote Sensing, 5-9 Nov. 2001, Boulder, CO, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Cold Land Processes Field Experiment (CLPX) has been designed to advance our understanding of the terrestrial cryosphere. Developing a more complete understanding of fluxes, storage, and transformations of water and energy in cold land areas is a critical focus of the NASA Earth Science Enterprise Research Strategy, the NASA Global Water and Energy Cycle (GWEC) Initiative, the Global Energy and Water Cycle Experiment (GEWEX), and the GEWEX Americas Prediction Project (GAPP). The movement of water and energy through cold regions in turn plays a large role in ecological activity and biogeochemical cycles. Quantitative understanding of cold land processes over large areas will require synergistic advancements in 1) understanding how cold land processes, most comprehensively understood at local or hillslope scales, extend to larger scales, 2) improved representation of cold land processes in coupled and uncoupled land-surface models, and 3) a breakthrough in large-scale observation of hydrologic properties, including snow characteristics, soil moisture, the extent of frozen soils, and the transition between frozen and thawed soil conditions. The CLPX Plan has been developed through the efforts of over 60 interested scientists that have participated in the NASA Cold Land Processes Working Group (CLPWG). This group is charged with the task of assessing, planning and implementing the required background science, technology, and application infrastructure to support successful land surface hydrology remote sensing space missions. A major product of the experiment will be a comprehensive, legacy data set that will energize many aspects of cold land processes research. The CLPX will focus on developing the quantitative understanding, models, and measurements necessary to extend our local-scale understanding of water fluxes, storage, and transformations to regional and global scales. The experiment will particularly emphasize developing a strong synergism between process-oriented understanding, land surface models and microwave remote sensing. The experimental design is a multi-sensor, multi-scale (1-ha to 160,000 km ^ {2}) approach to providing the comprehensive data set necessary to address several experiment objectives. A description focusing on the microwave remote sensing components (ground, airborne, and spaceborne) of the experiment will be presented.

Author

*Cryospheres; Remote Sensing; Space Missions; Microwave Imagery; Biogeochemistry; Hydrology; Earth Sciences*

**20020019419** BAE Systems, Rome, NY USA

**The PinPoint System Definition Study** ***Final Report, Oct. 1999-Mar. 2000***

Clark, C. R.; Shanafelt, R. E.; Jul. 2001; 44p; In English; Prepared in cooperation with Radix Technologies, Inc., Mountain View, CA

Contract(s)/Grant(s): F30602-99-D-0152; F30602-99-D-0002; AF Proj. R601

Report No.(s): AD-A397108; AFRL-IF-RS-TR-2001-150; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of the PinPoint program is to integrate adaptive beamforming techniques for co-channel interference cancellation with Time Difference Arrival - Differential Doppler (TDOA-DD) processing for rapid and precise geolocation of low-power tactical emitters in a dense co-channel environment. The end goal of the PinPoint program is to demonstrate the battlefield imaging technology required to provide the commander with a highly sensitive, robust, precise and real-time geographical awareness of the tactical emitter scenario. The PinPoint program is structured as a multi-phase effort beginning with the Phase 0 study reported on herein. The PinPoint Demonstration System will be developed in Phase I, currently under contract. In Phase II the system will be integrated with a suitable multi-antenna collection system such as, but not strictly limited to, LBSS or the Army Testbed Unit. Flight testing is planned for Phase III. The Phase 0 program was a feasibility study to identify and address the critical technology risk areas associated with integrating beamforming with precision geolocation, through a combination of analysis, algorithm development, simulation, and architecture trades.

DTIC

*Beamforming; Electromagnetic Interference; Imaging Techniques; Systems Analysis; Algorithms; Computerized Simulation*

**20020019798** NASA Marshall Space Flight Center, Huntsville, AL USA

**Recent Advances in Maya Studies Using Remotely Sensed Data**

Sever, Tom; Irwin, Daniel; [2001]; 1p; In English; The Reconstruction of Archaeological Landscapes Through Digital Technology Conference, 1-3 Nov. 2001, Boston, MA, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Peten region of northern Guatemala is one of the last places on earth where major archeological sites remain to be discovered. It was in this region that the Maya civilization began, flourished, and abruptly disappeared. Remote sensing technology is helping to locate and map ancient Maya sites that are threatened today by accelerating deforestation and looting. Thematic Mapper and IKONOS satellite and airborne Star3i radar data, combined with Global Positioning System (GPS) technology, are successfully detecting ancient Maya features such as cities, roadways, canals, and water reservoirs. Satellite imagery is also being used to map the bajos, which are seasonally flooded swamps that cover over 40% of the land surface. The use of baJos for farming has been a source of debate within the professional community for many years. But the recent detection and verification of cultural features within the baJo system by our research team are providing conclusive evidence that the ancient Maya had adapted well to wetland environments from the earliest times and utilized them until the time of the Maya collapse. The combination of water management and baJo farming is an important resource for the future of the current inhabitants who are experiencing rapid population growth. Remote sensing imagery is also demonstrating that in the Preclassic period (600 BC- AD 250), the Maya had already achieved a high organizational level as evidenced by the construction of massive temples and an elaborate inter-connecting roadway system. Although they experienced several setbacks such as droughts and hurricanes, the Maya nevertheless managed the delicate forest ecosystem successfully for several centuries. However, around AD 800, something happened to the Maya to cause their rapid decline and eventual disappearance from the region. The evidence indicates that at this time there was increased climatic dryness, extensive deforestation, overpopulation, and widespread warfare. This raises a relevant question today-namely, how severe do internal stresses in a civilization have to become before relatively minor climate shifts can cause a widespread cultural collapse?

Author

*Archaeology; Remote Sensing; Marshlands; Climatology; Airborne Radar; Thematic Mappers (LANDSAT)*

**20020019817** Alabama Univ., Dept. of Mathematics, Huntsville, AL USA

**EPBST Workstation Improvement: Automated Point Matching** ***Final Report, 24 Nov. 1999-30 Sep. 2000***

Dow, Stephen J.; Nov. 11, 2001; 9p; In English

Contract(s)/Grant(s): DAAH01-97-D-R005

Report No.(s): AD-A397084; 5-20801; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

As part of the workflow of the EPBST workstation software for building terrain models, point correspondences (x1, y1), (x2, y2), representing the locations of a common physical feature in two images, must be identified. Early versions of the software required that all such point correspondences be identified manually. This report describes the methodology used in adding automated point matching to the software, using: (1) interest point detection, (2) correlation, (3) consistency checks, and (4) subpixel refinement by least squares adjustment.

DTIC

*Boundary Value Problems; Automatic Control; Correlation*

**20020020470** Los Alamos National Lab., NM USA

**Evolving forest fire burn severity classification algorithms for multi-spectral imagery**

Brumby, S.; Mar. 01, 2001; 11p; In English

Report No.(s): DE2001-776131; LA-UR-01-1500; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Between May 6 and May 18, 2000, the Cerro Grande/Los Alamos wildfire burned approximately 43,000 acres (17,500 ha) and 235 residences in the town of Los Alamos, NM. Initial estimates of forest damage included 17,000 acres (6,900 ha) of 70-100% tree mortality. Restoration efforts following the fire were complicated by the large scale of the fire, and by the presence of extensive natural and man-made hazards. These conditions forced a reliance on remote sensing techniques for mapping and classifying the burn region. During and after the fire, remote-sensing data was acquired from a variety of aircraft-based and satellite-based sensors, including LANDSAT 7. We now report on the application of a machine learning technique, implemented in a software package called GENIE, to the classification of forest fire burn severity using LANDSAT 7 ETM+ multispectral imagery. The details of this automatic classification are compared to the manually produced burn classification, which was derived from field observations and manual interpretation of high-resolution aerial color/infrared photography.

NTIS

*Remote Sensing; Forests; Fires; Applications Programs (Computers); Image Classification*

## 44
## ENERGY PRODUCTION AND CONVERSION

*Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.*

**20020016099** National Renewable Energy Lab., Golden, CO USA
**NREL unsteady aerodynamics experiment in the NASA-Ames wind tunnel: A comparison of predictions to measurements**
Simms, D.; Schreck, S.; Hand, M.; Fingersh, L. J.; Jun. 22, 2001; 51p; In English
Report No.(s): DE2001-783409; NREL/TP-500-29494; No Copyright; Avail: Department of Energy Information Bridge

Currently, wind turbine designers rely on safety factors to compensate for the effects of unknown loads acting on the turbine structure. This results in components that are overdesigned because precise load levels and load paths are unknown. to advance wind turbine technology, the forces acting on the turbine structure must be accurately characterized because these forces translate directly into loads imparted to the wind turbine structure and resulting power production. Once these forces are more accurately characterized, we will better understand load paths and can therefore optimize turbine structures. to address this problem, the National Renewable Energy Laboratory (NREL) conducted the Unsteady Aerodynamics Experiment (UAE), which was a test of an extensively instrumented wind turbine in the giant NASA-Ames 24.4 m (80 feet) by 36.6 m (120 feet) wind tunnel. to maximize the benefits from testing, NREL formed a Science Panel of advisers comprised of wind turbine aerodynamics and modeling experts throughout the world. NREL used the Science Panel's guidance to specify the conditions and configurations under which the turbine was operated in the wind tunnel. The panel also helped define test priorities and objectives that would be effective for wind turbine modeling tool development and validation.
NTIS
*Unsteady Aerodynamics; Wind Tunnel Tests; Wind Turbines*

**20020016179** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Hawaii Zuteck Rotor Project: Compilation of project reports**
Zuteck, M. D.; Miller, M. W.; Feb. 25, 1999; 190p; In English
Report No.(s): DE2001-750917; NREL/SR-500-26086; No Copyright; Avail: Department of Energy Information Bridge

Summarizes project to design and build aileron retrofit blades for a 600 kW upwind, teetered rotor, full-span pitch control, horizontal-axis wind turbine.
NTIS
*Wind Tunnel Tests; Ailerons; Wind Turbines; Rotor Blades (Turbomachinery); Design Analysis*

**20020016220** National Renewable Energy Lab., Golden, CO USA
**Solar Electricity: The Power of Choice, First Quarter 2001**
Poole, L.; Schnelten, K.; Moon, S.; Apr. 26, 2001; 12p; In English
Report No.(s): DE2001-783555; NREL/BR-520-29629; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Solar Electricity--The Power of Choice (formerly NREL PV Working With Industry) is a quarterly newsletter devoted to the research and development activities performed by NREL staff in concert with their industry and university partners. This issue is devoted to NREL's renewables workshop for farmers and ranchers, presented at the National Western Stock Show in Denver; the PV Industry Roadmap; the Siemens Solar Industries celebration of 200 MW of cumulative PV module production; and a profile of 'PV Beyond the Horizon' initiative. The editorialist for this issue is Tim Anderson of the University of Florida.
NTIS
*Solar Energy; Electricity; Industries*

**20020016222** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Energy use and carbon dioxide emissions in the steel sector in key developing countries**
Price, L. K.; Phylipsen, G. J. M.; Worrell, E.; Apr. 01, 2001; 32p; In English
Report No.(s): DE2001-783473; LBNL-46987; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Iron and steel production consumes enormous quantities of energy, especially in developing countries where outdated, inefficient technologies are still used to produce iron and steel. Carbon dioxide emissions from steel production, which range between 5% and 15% of total country emissions in key developing countries (Brazil, China, India, Mexico, and South Africa), will continue to grow as these countries develop and as demand for steel products such as materials, automobiles, and appliances

increases. In this report, we describe the key steel processes, discuss typical energy-intensity values for these processes, review historical trends in iron and steel production by process in five key developing countries, describe the steel industry in each of the five key developing countries, present international comparisons of energy use and carbon dioxide emissions among these countries, and provide our assessment of the technical potential to reduce these emissions based on best-practice benchmarking. Using a best practice benchmark, we find that significant savings, in the range of 33% to 49% of total primary energy used to produce steel, are technically possible in these countries. Similarly, we find that the technical potential for reducing intensities of carbon dioxide emissions ranges between 26% and 49% of total carbon dioxide emissions from steel production in these countries.
NTIS
*Energy Consumption; Carbon Dioxide; Developing Nations; Iron; Steels*

**20020016224** National Renewable Energy Lab., Golden, CO USA
**Technical and Economic Feasibility Assessment of a Brightfield Photovoltaic Power Plant at Miramar Landfill** ***Final Report***
Jun. 21, 2001; 103p; In English
Report No.(s): DE2001-783444; NREL/BK-710-30478; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In partnership with the City of San Diego, the U.S. Department of Energy funded a study to determine the feasibility of developing up to a 1 MW Brightfield on a landfill.
NTIS
*Solar Generators; Landfills*

**20020016225** National Renewable Energy Lab., Golden, CO USA
**Processing of CuInSe2-Based Solar Cells: Characterization of Deposition Processes in Terms of Chemical Reaction Analyses** ***Final Report, 6 May 1995 - 31 Dec. 1998***
Anderson, T. J.; Stanbery, B. J.; Jul. 16, 2001; 422p; In English
Report No.(s): DE2001-783443; NREL/SR-520-30391; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This project describes a novel rotating-disc reactor that has been designed and built to enable modulated flux deposition of CuInSe2 and its related binary compounds. The reactor incorporates both a thermally activated source and a novel plasma-activated source of selenium vapor, which have been used for the growth of epitaxial and polycrystalline thin-film layers of CuInSe2. A comparison of the different selenium reactant sources has shown evidence of increases in its incorporation when using the plasma source, but no measurable change when the thermally activated source was used. We concluded that the chemical reactivity of selenium vapor from the plasma source is significantly greater than that provided by the other sources studied. Epitaxially grown CuInSe2 layers on GaAs, ZnTe, and SRF2 demonstrate the importance of nucleation effects on the morphology and crystallographic structure of the resulting materials. These studies have resulted in the first reported growth of the CuAu type-I crystallographic polytype of CuInSe2, and the first reported epitaxial growth of CuInSe2 on ZnTe. Polycrystalline binary (Cu,Se) and (In,Se) thin films have been grown, and the molar flux ratio of selenium to metals was varied. It is shown that all of the reported binary compounds in each of the corresponding binary phase fields can be synthesized by the modulated flux deposition technique implemented in the reactor by controlling this ratio and the substrate temperature. These results were employed to deposit bilayer thin films of specific (Cu,Se) and (In,Se) compounds with low melting-point temperature, which were used to verify the feasibility of synthesizing CuInSe2 by subsequent rapid-thermal processing.
NTIS
*Copper Selenides; Indium Compounds; Binary Systems (Materials); Solar Cells; Deposition*

**20020016226** National Renewable Energy Lab., Golden, CO USA
**Small-Scale Geothermal Power Plant Field Verification Projects: Preprint**
Kutscher, C.; Jul. 03, 2001; 14p; In English
Report No.(s): DE2001-783442; NREL/CP-550-30275; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In the spring of 2000, the National Renewable Energy Laboratory issued a Request for Proposal for the construction of small-scale (300 kilowatt (kW) to 1 megawatt (MW)) geothermal power plants in the western USA. Five projects were selected for funding. of these five, subcontracts have been completed for three, and preliminary design work is being conducted. The three projects currently under contract represent a variety of concepts and locations: a 1-MW evaporatively enhanced, air-cooled

binary-cycle plant in Nevada; a 1-MW water-cooled Kalina-cycle plant in New Mexico; and a 750-kW low-temperature flash plant in Utah. All three also incorporate direct heating: onion dehydration, heating for a fish hatchery, and greenhouse heating, respectively. These projects are expected to begin operation between April 2002 and September 2003. In each case, detailed data on performance and costs will be taken over a 3-year period.
NTIS
*Geothermal Energy Utilization; Geothermal Technology*

**20020016228** National Renewable Energy Lab., Golden, CO USA
**PowerGuard Advanced Manufacturing: PVMaT** ***Progress Report, 1 Jul. 1999 - 30 Sep. 2000***
Dinwoodie, T. L.; Botkin, J.; Jun. 05, 2001; 39p; In English
Report No.(s): DE2001-783440; NREL/SR-520-30247; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This project introduced incremental improvements to PowerGuard system components and manufacturing processes to significantly reduce the costs of a PowerGuard system. The improvement resulted in a lower cost, higher impact PV product. During Phase II, these accomplishments have resulted in: A production rate of greater than 400 PowerGuard tiles per shift (20 MW/year) manufacturing capacity; 57% cost reduction for PowerGuard tile; UL listing for four additional PowerGuard tiles configurations; Improved quality of finished goods due to improved tooling and processes in manufacturing, simultaneously improving throughput and lowering cost of $3.80Wp for large systems. In Phase III of this contract, PowerLight will continue efforts to improve the manufacturing processes for PowerGuard. Specific performance objectives during phase III are as follows: Demonstrate system cost reduction from $3.80/Wp to $3.05/Wp for large systems; Establish or assess the performance of dedicated PowerGuard PV module plant capacity of 2 MW per year; Complete wind tunnel testing of all design refinements; Produce an installation manual and training program for installing PowerGuard systems; Establish performance of manufacturing modifications based on assessment of commercial systems which incorporate the new features and processes; and Finalize UL, International Conference of Building Officials (ICBO), and international listings of PowerGuard improvements. These are expected to result in a lower cost, higher impact PV product, as sought by this program.
NTIS
*Photovoltaic Conversion; Tiles*

**20020016229** National Renewable Energy Lab., Golden, CO USA
**Mid-Atlantic Region Consumer's Guide to Buying a Solar Electric System. Revision**
Jun. 19, 2001; 24p; In English
Report No.(s): DE2001-783439; NREL/BR-520-30164; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Consumers in Pennsylvania, Virginia, Delaware, Maryland, the District of Columbia, West Virginia, and New Jersey are showing increased interest in solar electric systems for their homes and businesses. This booklet provides basic information about buying a PV system. Photovoltaic (PV) systems are reliable, pollution free, and use a renewable source of energy - the sun. A PV system can be a substantial investment and careful planning will help ensure that you make the right decisions.
NTIS
*Photovoltaic Conversion; Renewable Energy; Consumers*

**20020016231** National Renewable Energy Lab., Golden, CO USA
**Solar Water Heaters: The Next Generation**
Burch, J.; Mar. 30, 2001; 2p; In English
Report No.(s): DE2001-783414; DOE/GO-102001-1289; NREL/FS-550-29914; No Copyright; Avail: Department of Energy Information Bridge

The U.S. Department of Energy is pursuing an aggressive goal to cut the cost of solar water-heating systems in half. Replacing metal and glass components with less expensive plastic ones is a key strategy for that goal. This is a short (2-page) fact sheet about new technologies for solar water heaters.
NTIS
*Solar Heating; Water; Costs*

**20020016232** National Renewable Energy Lab., Golden, CO USA
**Factors Associated with Photovoltaic System Costs (Topical Issues Brief)**
Mortensen, J.; Jun. 12, 2001; 17p; In English
Report No.(s): DE2001-783411; NREL/TP-620-29649; No Copyright; Avail: Department of Energy Information Bridge
A variety of factors can affect the cost of photovoltaic systems. This report analyses the relationship among such factors by using information entered into a voluntary registry of PV systems and performing regression analyses. The results showed statistically significant relationships between photovoltaic system cost and: (1) grid connection, (2) installation year, (3) areas where the utility had entered into volume purchasing agreements.
NTIS
*Photovoltaic Conversion; Costs*

**20020016233** National Renewable Energy Lab., Golden, CO USA
**WindPACT Turbine Design Scaling Studies Technical Area 3: Self-Erecting Tower and Nacelle Feasibility, *Mar. 2000 - Mar. 2001***
May 31, 2001; 72p; In English
Report No.(s): DE2001-783408; NREL/SR-500-29493; No Copyright; Avail: Department of Energy Information Bridge
The USA Department of Energy (DOE), through the National Renewable Energy Laboratory (NREL), has implemented the Wind Partnerships for Advanced Component Technologies (WindPACT) program to explore advanced technologies for improving the reliability and cost-effectiveness of wind energy technology. Global Energy Concepts (GEC) prepared this report on self-erecting towers as part of the WindPACT program. The objectives of the work were to identify potential methods for erecting wind turbine towers without the use of large conventional cranes, establish the most promising methods, and compare the costs of the most promising methods to the costs of conventional cranes.
NTIS
*Windpower Utilization; Wind Turbines; Nacelles*

**20020016235** National Renewable Energy Lab., Golden, CO USA
**WindPACT Turbine Design Scaling Studies Technical Area 1: Composite Blades for 80- to 120-Meter Rotor**
Griffin, D. A.; Apr. 30, 2001; 44p; In English
Report No.(s): DE2001-783406; NREL/SR-500-29492; No Copyright; Avail: Department of Energy Information Bridge
The USA Department of Energy (DOE) through the National Renewable Energy Laboratory (NREL) implemented the Wind Partnership for Advanced Component Technologies (WindPACT) program. As part of the WindPACT program, Global Energy Concepts, LLC (GEC), was awarded contract number YAM-0-30203-01 to examine Technical Area 1-Blade Scaling, Technical Area 2-Turbine Rotor and Blade Logistics, and Technical Area 3-Self-Erecting Towers. This report documents the results of GEC's Technical Area 1-Blade Scaling. The primary objectives of the Blade-Scaling Study are to assess the scaling of current materials and manufacturing technologies for blades of 40 to 60 meters in length, and to develop scaling curves of estimated cost and mass for rotor blades in that size range.
NTIS
*Windpower Utilization; Turbine Blades*

**20020016372** National Renewable Energy Lab., Golden, CO USA
**Simple Design and Manufacturing Process for High-Intensity Silicon Vertical Multi-Junction Solar Cells: Inventions and Innovation Project Fact Sheet**
Jan. 17, 2001; 4p; In English
Report No.(s): DE2001-783548; DOE/GO-102001-1038; NREL/FS-810-28264; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Project fact sheet written for the Inventions and Innovation Program about a breakthrough in solar cells in photovoltaic concentrator systems that will create cost savings in the industry.
NTIS
*Solar Cells; Manufacturing; Design Analysis; Silicon*

**20020016379** National Renewable Energy Lab., Golden, CO USA
**NREL PV Working with Industry *Quarterly Report, 2000***
Poole, L.; Dec. 26, 2000; 12p; In English
Report No.(s): DE2001-783401; NREL/BR-520-29133; No Copyright; Avail: Department of Energy Information Bridge

'NREL PV Working with Industry' is a quarterly newsletter devoted to the research, development, and deployment performed by NREL staff in concert with their industry and university partners. The fourth quarter contains an article that is a follow-up to the IEEE PVSC conference held in Alaska in September 2000, an article about two new research and development initiatives, and an article on cooperative research efforts between the NCPV and the Solar Buildings and Concentrating Solar Power programs. The editorialist is Jim Rannels, Director of the Office of Power Technologies.
NTIS
*Deployment; Solar Energy; Research and Development*

**20020016383** National Renewable Energy Lab., Golden, CO USA
**RPM-SIM Simulator: A Comparison of Simulated Versus Recorded Data (Preprint)**
Bialasiewicz, J. T.; Muljadi, E.; Nix, G.; Drouilhet, S.; Jul. 25, 2001; 14p; In English
Report No.(s): DE2001-784660; NREL/CP-500-29174; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper compares simulated versus recorded data for the RPM-SIM simulator, developed at the National Renewable Energy Laboratory's National Wind Technology Center. The simulator was used to study the system dynamics of a wind/diesel hybrid power system. We also provide information on newly developed simulator modules that will be released. The simulator performed extremely well, demonstrating flexibility in making modifications and including specialized modules required for problem solving. We also outline several possible applications for this tool.
NTIS
*Renewable Energy; Energy Technology; Windpower Utilization; Modules*

**20020016445** National Renewable Energy Lab., Golden, CO USA
**Deep-Discharge Zinc-Bromine Battery Module Offers Megawatts Capacity: Inventions and Innovation Project Fact Sheet**
Jan. 25, 2001; 2p; In English
Report No.(s): DE2001-783551; DOE/GO-102001-1169; NREL/FS-810-29466; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Project fact sheet written for the Inventions and Innovation Program about a new technology that increases load-leveling efficiency and offers longer cycle life than lead-acid batteries.
NTIS
*Bromine; Electric Batteries; Zinc; Lead Acid Batteries*

**20020016448** National Renewable Energy Lab., Golden, CO USA
**Wind Power Today: 2000 Wind Energy Program Highlights**
Weis-Taylor, W.; May 08, 2001; 40p; In English
Report No.(s): DE2001-783398; DOE/GO-102001-1325; NREL/BK-500-28921; No Copyright; Avail: Department of Energy Information Bridge

Wind Power Today is an annual publication that provides an overview of the US Department of Energy's (DoE's) Wind Energy Program. The purpose of Wind Power Today is to show how DoE's Wind Energy Program supports wind turbine research and deployment in hopes of furthering the advancement of wind technologies that produce clean, low-cost, reliable energy. Content objectives include: educate readers about the advantages and potential for widespread deployment of wind energy; explain the program's objectives and goals; describe the program's accomplishments in research and application; examine the barriers to widespread deployment; describe the benefits of continued research and development; facilitate technology transfer; and attract cooperative wind energy projects with industry.
NTIS
*Clean Energy; Deployment; Windpower Utilization*

**20020016450** National Renewable Energy Lab., Golden, CO USA
**PVMaT-OMNION Series 3000: Photovoltaic Power Conversion System for Utility Interconnected Application *Annual Report, May 1997 - Feb. 1999***
Porter, D.; Sep. 13, 2000; 97p; In English
Report No.(s): DE2001-783396; NREL/SR-520-28820; No Copyright; Avail: Department of Energy Information Bridge

This report details the work performed which was geared towards making advancements in three major areas (cost, reliability, and performance) of three-phase, utility interconnected, and photovoltaic power conversion.
NTIS
*Electric Power Supplies; Photovoltaic Conversion*

**20020016472** National Renewable Energy Lab., Golden, CO USA
**NedWind 25 Blade Testing at NREL for the European Standards Measurement and Testing Program**
Larwood, S.; Musial, W.; Freebury, G.; Beattie, A. G.; Apr. 19, 2001; 253p; In English
Report No.(s): DE2001-784655; NREL/TP-500-29103; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In the mid-90s the European community initiated the Standards, Measurements, and Testing (SMT) program to harmonize testing and measurement procedures in several industries. Within the program, a project was carried out called the European Wind Turbine Testing Procedure Development. The second part of that project, called Blade Test Methods and Techniques, included the United States and was devised to help blade-testing laboratories harmonize their testing methods. This report provides the results of those tests conducted by the National Renewable Energy Laboratory.
NTIS
*Wind Turbines; Tests; Renewable Energy*

**20020016473** National Renewable Energy Lab., Golden, CO USA
**Geothermal Energy Heat from the Earth: Nevada; GeoPowering the West Series Fact Sheet**
Boddy, S.; Jul. 19, 2001; 2p; In English
Report No.(s): DE2001-784661; DOE/GO-102001-1432; NREL/FS-810-29214; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

General use fact sheet about geothermal energy in Nevada. Nevada holds the largest amount of untapped geothermal resources in the U.S., with a potential of 2,500 to 3,700 megawatts of electricity (Mwe).
NTIS
*Geothermal Resources; Geothermal Technology*

**20020016681** National Renewable Energy Lab., Golden, CO USA
**Highlighting High Performance: The Solar Energy Research Facility, Golden, Colorado**
Torcellini, P.; Epstein, K.; Jun. 26, 2001; 3p; In English
Report No.(s): DE2001-784677; DOE/GO-102001-1279; NREL/BR-550-29390; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The National Renewable Energy Laboratory's Solar Energy Research Facility in Golden, Colorado, uses a stair-step configuration to allow daylight and heat into the office areas, while the laboratories in the back of the building are in a more controlled environment where tight levels of ventilation, humidity, temperature, and light are critical. A unique mechanical system makes the most of the natural environment and the buildings design to efficiently heat and cool the building at an annual utility bill savings of almost $200,000 per year.
NTIS
*Solar Energy; Renewable Energy; Controlled Atmospheres; Buildings; Research Facilities*

**20020016682** National Renewable Energy Lab., Golden, CO USA
**Wind Energy Resource Atlas of the Philippines**
Elliott, D.; Schwartz, M.; George, R.; Haymes, S.; Heimiller, D.; Mar. 06, 2001; 206p; In English
Report No.(s): DE2001-784669; NREL/TP-500-26129; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report contains the results of a wind resource analysis and mapping study for the Philippine archipelago. The study's objective was to identify potential wind resource areas and quantify the value of those resources within those areas. The wind resource maps and other wind resource characteristic information will be used to identify prospective areas for wind-energy applications.
NTIS
*Philippines; Windpower Utilization*

**20020016691** Sandia National Labs., Albuquerque, NM USA

**Development History of Fe/KClO(sub 4) Heat Powders at Sandia and Related Aging Issues for Thermal Batteries**

Guidotti,; Jul. 01, 2001; 42p; In English

Report No.(s): DE2001-783995; SAND2001-2191; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Pelletized pyrotechnic discs (”heat pellets”) are used in thermally activated (”thermal”) batteries for nuclear weapons for the Department of Energy (DOE) as well as in a large variety of missiles for the Department of Defense. Thermal batteries provide the primary power for these applications and depend on a molten-salt electrolyte. The batteries deliver power upon melting of the electrolyte caused by the heat released during burning of heat pellets in the battery stack. Prior to the use of heat pellets, a heat paper based on Zr/BaCrO4 was used as the heat source in thermal batteries. This material had a number of disadvantages, including static and shock sensitivity and forming highly resistive reaction products that would not allow for intercell connection of cells in a stack. This report describes the history of the development of pelletized pyrotechnics at Sandia National Laboratories for the DOE’s nuclear weapons. The final chemistry selected was Fe/KClO4, since it met all of the desired qualities for the anticipated applications. This report also provides relevant historical aging data for this material, as well as related data generated as part of a stockpile surveillance program.

NTIS

*Potassium Perchlorates; Iron; Metal Powder; Thermal Batteries; Aging (Metallurgy)*

**20020017476** Federal Energy Technology Center, Morgantown, WV USA

**Low-Temperature, Anode-Supported High Power Density Solid Oxide Fuel Cells with Nanostructured Electrodes**

Virkar, A. V.; Apr. 07, 2000; 30p; In English

Report No.(s): DE2001-784599; AC26-99FT40713-04; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Nanosize yttria-stabilized zirconia (YSZ) was synthesized by a unique approach based on molecular decomposition. In this approach, yttria-doped BaZrO3 (Y-BaZrO3) or yttria-doped Na2ZrO3 (Y-Na2ZrO3) precursors were first synthesized from BaCO3, ZrO2, Y2O3 or BaCO3 and commercial YSZ for Y-BaZrO3, and from Na2CO3 and YSZ for Y-Na2ZrO3, by a conventional solid state reaction method. Then, the precursors were boiled to leach away the unwanted species, BaO or Na2O, either in a dilute HNO3 solution in water in the case of Y-BaZrO3, or in de-ionized water in the case of Y-Na2ZrO3. During boiling in HNO3 or water, the insoluble residue of Zr-Y-O composition formed fine, nanosize YSZ particles. X-ray diffraction (XRD) and specific surface area measurements on the as-synthesized powders confirmed the formation of nanosize YSZ. A subsequent heating in air led to particle growth. However, for a treatment at a temperature as high as 1000 C, the particle size was well in the nanosize range. XRD showed that the as-synthesized YSZ powders, as well as those heated up to 1000 C, the maximum temperature the powders were heated to after leaching, are of cubic structure.

NTIS

*Solid Oxide Fuel Cells; Electrodes; Yttria-Stabilized Zirconia*

**20020017696** Netherlands Energy Research Foundation, Petten, Netherlands

**Financial Sustainability of PV Implementation in Swaziland**

Westra, C. A.; van Roekel, G. M.; Lasschuit, P. E.; Oct. 2001; 8p; In English

Report No.(s): PB2002-101086; ECN-RX-01-050; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

During the past 10 years, more than 700 Solar Home Systems have been implemented by this project in Swaziland, Southern Africa. The implementation process started with house energy surveys, the results of which showing significant energy needs for cooking, lighting, and basic communication applications (i.e. radio/TV), particularly in rural areas. An implementation project of Solar Home Systems was set up to start rural electricification with solar PV (photovoltaics) and focused on lighting and small electrical demands. The national government, whose own resources were limited, supported the project as an important step towards addressing the country’s range of energy needs. Together with a local company, Swazitronix, a joint venture was established to facilitate the implementation project. With a project loan from the Dutch social bank, the Triodosbank, standard Solar Home Systems were sold, assembled, installed and serviced. Customers paid the full cost of their PV systems and services. Awareness and education issues also formed key aspects of the project. During a later project phase, credit financing instruments were introduced providing a final element of experience crucial to future project phase, credit financing instruments were introduced providing a final element of experience crucial to future project implementation.

NTIS

*Solar Houses; Energy Technology; Photovoltaic Conversion; Electrification*

**20020018125** Federal Energy Technology Center, Morgantown, WV USA

**UTSI/CFFF MHD Program Completion and Related Activity**

Jul. 01, 2001; 8p; In English

Report No.(s): DE2001-785196; AC22-95PC95231-37; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Maintenance work on the DOE CFFF facility and other related government property is no longer authorized under this contract in accordance with the DOE-UT Settlement Agreement..Environmental remediation preservation of the facility continued. Government property has been transferred to UTSI as owner which frees up many items for proper disposal. Actions are underway to dispose of other wastes, and control pests and water at the DOE CFFF.

NTIS

*Magnetohydrodynamics; Waste Disposal*

**20020018129** Federal Energy Technology Center, Morgantown, WV USA

**Development of Technologies and Analytical Capabilities for Vision 21 Energy Plants**

Syamlal, M.; Jul. 10, 2001; 15p; In English

Report No.(s): DE2001-785120; FC26-00NT40954-03; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The training of a new project team member was completed. The Software Requirements Document was written. It was determined that the CAPE-OPEN interfaces are sufficient for the communication between Fluent and V21 Controller. The AspenPlus-Fluent prototype on allyl/triacetone alcohol production was further developed to assist the graphical user interface and software design tasks. The prototype was also used to analyze the sensitivity of a process simulation result with respect to a parameter in a computational physics dynamics (CFD) model embedded in the process simulation. Thus the integration of process simulation and CFD provides additional process insights and enables the engineer to optimize overall process performance (e.g., product purity and yield) with respect to important CFD design and operation parameters (e.g., CSTR shaft speed). A top-level design of the V21 Controller was developed and discussed. A draft version of the Software Design Document was written. A preliminary software development plan was outlined. At first the V21 Controller will be developed and tested in two parts - a part that communicates with Fluent and a part that communicates with Aspen Plus. Then the two parts will be combined and tested with the allyl/triacetone alcohol flow sheet simulation. Much progress was made in writing the code for the two parts. A requirement for pre-configured models was identified and added to the software requirements document. Alstom Power's INDVU code was ported to the PC platform and received on the unit. Thus the preparation for linking INDVU code with the Aspen Plus model of RP&L unit is complete. A report describing Demo Case 1 was written and submitted to the Department of Energy for review and approval. The first Advisory Board meeting was held at the Fluent Users Group Meeting on June 6th. At the Advisory Board meeting, the project was reviewed, a demonstration was made, and verbal feedback was received. Meeting minutes have been issued. Global-CAPE-OPEN organization was contacted for obtaining draft specifications in CORBA that are needed for writing the interfaces between V21 Controller and Fluent. Efforts are underway to establish collaboration with Norsk Hydro, who is leading a Global CAPE-OPEN project on linking CFD and process simulation models. Because of the similarity between that project and the present project, the two project teams can learn much from each other.

NTIS

*Computational Fluid Dynamics; Control Systems Design; Prototypes; Computerized Simulation; Software Engineering*

**20020018166** Netherlands Energy Research Foundation, Petten, Netherlands

**Long-Term Stability and Efficiency of Dye-Sensitized Solar Cells**

Hinsch, A.; Kroon, J. M.; Kern, R.; Meyer, A.; Uhlendorf, I.; Oct. 2001; 8p; In English; Prepared in cooperation with Freiburger Materialforschungszentrum, Breisgau, Germany

Report No.(s): PB2002-101316; ECN-RX-01-020; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

For the first time, a certified AMI.5 efficiency of 8.2% has been reached for nano-crystalline dye-sensitized solar cells (nc-DSC) on areas larger than 1 sq. cm. i.e. 2.5 sq. cm. It has been further proven, that 2-valent salts like MgI(sub 2) and CaI(sub 2) as additives to the electrolyte have a strong stabilizing effect during UV (ultraviolet) illumination. Tests under continuous light soaking for several thousand hours demonstrate the ability of nc-DSCs to operate for at least five to ten years under outdoor illumination conditions without major degradations. Continuous and periodic thermal tests according to IEC (International Electrotechnical Commission) 1215 norms are promising but with 30% to 40% loss in efficiency still critical.

NTIS

*Solar Cells; Design Optimization; Photovoltaic Conversion*

**20020018167** Netherlands Energy Research Foundation, Petten, Netherlands

**Comparison of Emitters Diffused Using an IR Belt Furnace and a POCl(sub 3) System**

Goris, M. J. A.; Weeber, A. W.; Jooss, W.; Huster, F.; Oct. 2001; 8p; In English; 17th; European Photovoltaic Solar Energy Conference and Exhibition, 22-26 Oct. 2001, Munich, Germany

Report No.(s): PB2002-101099; ECN-RX-01-017; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

In this study emitters diffused using an infrared (IR) lamp heated belt furnace are compared to emitters made with a POCl(sub 3) system. Emitter diffusion in an IR belt furnace was optimized in such a way that the results on multi-crystalline solar cells can compete with those for cells made using a POCl(sub 3) batch system. For solar cells made of long lifetime wafers selected from the top and middle of an ingot, the I-V parameters are the same for cells diffused with POCl(sub 3), and with IR. An important advantage of IR diffusion is that it improves the efficiency of cells from the bottom of the ingot to the same level as of wafers higher up in the ingot due to improved minority carrier lifetime.

NTIS

*Luminaires; Emitters; Furnaces*

**20020018168** Netherlands Energy Research Foundation, Petten, Netherlands

**New Low-Cost Modular Inverter Using Advanced ASIC Control: Rigorous Performance Tests Result in Rapid Adaptation to Market Demands**

Heskes, P. J. M.; Eikelboom, J. A.; Rooij, P. M.; Bettenwort, G.; Margaritis, B.; Oct. 2001; 8p; In English

Report No.(s): PB2002-101098; ECN-RX-01-019; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Laboratory tests on a new modular inverter using an application-specific integrated circuit (ASIC) are discussed. The inverter design is optimized for Ascom's large-scale telecom production facilities. The ASIC is developed by means of sophisticated simulation tools and is the key controlling unit in the design. The electrical properties of the inverter, such as efficiency of power conversion, quality of delivered energy and behavior of a large number of inverters in parallel are tested by the Energy Research Centre of the Netherlands (ECN). Special attention is paid to the behavior of inverters in parallel in relation to harmonic distortion, to estimate the effect of large-scale PV (photovoltaic) integration. This design process resulted in a rapid adaptation to market demands for a new low-cost inverter and brought the final user price below one epsilon/W and the warranty period to ten years.

NTIS

*Solar Energy Conversion; Inverters; Application Specific Integrated Circuits; Photovoltaic Cells*

**20020018170** Netherlands Energy Research Foundation, Petten, Netherlands

**Monitoring of Solar Home Systems in China: First Year Results**

Nieuwenhout, F. D. J.; Vervaart, M. R.; van der Rijt, P. J. N. M.; Oct. 2001; 8p; In English; Original contains color illustrations

Report No.(s): PB2002-101083; ECN-RX-01-021; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Results are presented of the first year of monitoring solar home systems in three provinces in PR (People's Republic) China. With a limited number of measured parameters the operation of the systems can be monitored thoroughly. The 45 WpPV-modules are somewhat oversized for lighting use only. Energy Balance did not reveal any unnecessarily high system losses.

NTIS

*Solar Houses; China; Evaluation; Solar Energy Conversion*

**20020018171** Netherlands Energy Research Foundation, Petten, Netherlands

**Hot String and the Cool Module: Case Study of Default Detection in PV Systems by Means of IR Photography**

Eikelboom, J. A.; vanderBorg, N. J. C. M.; Jansen, M. J.; Oct. 2001; 22p; In English; Original contains color illustrations

Report No.(s): PB2002-101081; ECN-I-01-017; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

IR (Infrared) photography was used for the inspection of a PV (Photovoltaic) system on the facade of a building. The IR photographs showed five PV modules having a temperature that was significantly higher than that of neighboring modules. The open-circuit voltage and short-circuit current of the strings in the PV array were measured. It was concluded that a single module was connected in reverse in the string containing the hot modules. At the time the IR photograph was taken the PV inverter was not active and the PV array was effectively short-circuited. Thus the energy generated by the modules of the array was dissipated in the string with the module connected in reverse, which lead to the observed rise in the module temperature. The resulting current-voltage curves of the PV array are calculated using models of the electrical characteristics of multicrystalline Silicon modules.

NTIS

*Infrared Photography; Photovoltaic Cells; Fault Detection*

**20020018834** Netherlands Energy Research Foundation, Petten, Netherlands

**PEMSWECS: Performance Evaluation Methods for Autonomous, Applications Oriented Wind Turbine Systems *Final Report***

Pierik, J. T. P.; Dunlop, R. W.; Lee, W. K.; Gabriel, J.; Jun. 2001; 40p; In English

Report No.(s): PB2002-101065; ECN-C-01-090; Copyright; Avail: National Technical Information Service (NTIS)

The primary objective of the PEMSWECS project is to provide a technical basis for the standardization of power performance evaluation methods. This can serve as the basis for commercial warranties for autonomous, application orientated wind turbine systems. The project is largely testing based. It is complemented by analytical modeling, to provide a better understanding of system characteristics as well as to assist in performance prediction. This report gives an overview of the result of the project. Measurements and simulations to develop a method for the power performance evaluation of autonomous wind turbine systems are described. The report is a compilation of the detailed reports on measurements and evaluations on three stand alone wind turbine systems: a 6 kW proven system, equipped with a permanent magnet generator, diode rectifier, voltage controller and resistive load; a 4 kW Fortis Montana system, with a permanent magnet generator, diode rectifier, batteries, inverter and AC load; a 30 kW Sudwind system, with synchronous generator and controlled resistive load.

NTIS

*Autonomy; Mathematical Models; Performance Prediction; Wind Turbines; Electrical Properties*

**20020018845** Netherlands Energy Research Foundation, Petten, Netherlands

**Influence of Wafer Thickness on the Performance of Multicrystalline Si Solar Cells: An Experimental Study**

Tool, C. J. J.; Burgers, A. R.; Manshanden, P.; Weeber, A. W.; vanStraaten, B. H. M.; Oct. 2001; 22p; In English

Report No.(s): PB2002-101089; ECN-RX-01-041; Copyright; Avail: National Technical Information Service (NTIS)

The influence of the thickness of silicon solar cells has been investigated using neighboring multicrystalline silicon wafers with thickness ranging from 150 to 325 micrometers. For silicon solar cell structures with a high minority carrier diffusion length one expects that J would decrease as the wafer becomes thinner due to a shorter optical path length. It was found experimentally that J is nearly independent of the thickness of the solar cell, even when the minority carrier diffusion length is about 300 micrometers. This indicates that the A1 rear metallization acts at a good back surface reflector. A decrease in J is observed only if the wafer thickness becomes less than about 200 micrometers.

NTIS

*Wafers; Thickness; Crystallinity; Metallizing; Solar Cells*

**20020018903** Norfolk State Univ., Center for Materials Research, VA USA

**Novel High Efficient Organic Photovoltaic Materials**

Sun, Sam, Norfolk State Univ., USA; Haliburton, James, Norfolk State Univ., USA; Fan, Zben, Norfolk State Univ., USA; Taft, Charles, Norfolk State Univ., USA; Wang, Yi-Qing, Norfolk State Univ., USA; Maaref, Shahin, Norfolk State Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 30; In English; Also announced as 20020018881

Report No.(s): P22; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In man's mission to the outer space or a remote site, the most abundant, renewable, nonpolluting, and unlimited external energy source is light. Photovoltaic (PV) materials can convert light into electrical power. In order to generate appreciable electrical power in space or on the Earth, it is necessary to collect sunlight from large areas due to the low density of sunlight, and this would be very costly using current commercially available inorganic solar cells. Future organic or polymer based solar cells seemed very attractive due to several reasons. These include lightweight, flexible shape, ultra-fast optoelectronic response time (this also makes organic PV materials attractive for developing ultra-fast photo detectors), tunability of energy band-gaps via molecular design, versatile materials synthesis and device fabrication schemes, and much lower cost on large-scale industrial production. It has been predicted that nano-phase separated block copolymer systems containing electron rich donor blocks and electron deficient acceptor blocks will facilitate the charge separation and migration due to improved electronic ultrastructure and morphology in comparison to current polymer composite photovoltaic system. This presentation will describe our recent progress in the design, synthesis and characterization of a novel donor-bridge-acceptor block copolymer system for potential high-efficient organic optoelectronic applications. Specifically, the donor block contains an electron donating alkyloxy derivatized polyphenylenevinylene, the acceptor block contains an electron withdrawing alkyl-sulfone derivatized polyphenylenevinylene, and the bridge block contains an electronically neutral non-conjugated aliphatic hydrocarbon chain. The key synthetic strategy includes the synthesis of each individual block first, then couple the blocks together. While the donor block stabilizes the holes, the acceptor block stabilizes the electrons. The bridge block is designed to hinder the electron-hole recombination. Thus, improved charge separation is expected. In addition, charge migration will also be facilitated due to the expected nano-phase separated and

highly ordered block copolymer ultrastructural. The combination of all these factors will result in significant overall enhancement of photovoltaic power conversion efficiency.
Author
*Photovoltaic Conversion; Organic Materials; Solar Cells; Power Efficiency*

**20020018913** Texas Univ., Dept. of Electrical and Computer Engineering, El Paso, TX USA
**Kelvin Probe Measurements on Solar Cells and Other Thin Film Devices**
Delk, John, Texas Univ., USA; Dils, D. W., Texas Univ., USA; Lush, G. B., Texas Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 40; In English; Also announced as 20020018881
Report No.(s): P32; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Kelvin Probe (KP) has been used for years to measure the surface potential of metals and semiconductors. The KP is an elegantly simple but powerful tool invented by Lord Kelvin around the turn of the century. Using changes in surface potentials as a result of changing the intensity and wavelength of illumination, the KP returns data on material parameters such as band gap energies and the energy levels of interface states. We have employed the KP in the study of CdTe-based solar cells and quantum dot-based solar cells, as well as other thin-film devices. We hope eventually that the KP will be used as an in-line testing station for a fabrication process so that unfinished devices that will not meet requirements can be thrown out before the processing is completed, thus saving resources. Results of these studies will be presented.
Author
*Solar Cells; Thin Films; Metal Surfaces; Surface Properties*

**20020018914** Texas Univ., Dept. of Electrical and Computer Engineering, El Paso, TX USA
**Annealing of Solar Cells and Other Thin Film Devices**
Escobar, Hector, Texas Univ., USA; Kuhlman, Franz, Texas Univ., USA; Dils, D. W., Texas Univ., USA; Lush, G. B., Texas Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 41; In English; Also announced as 20020018881
Report No.(s): P33; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Annealing is a key step in most semiconductor fabrication processes, especially for thin films where annealing enhances performance by healing defects and increasing grain sizes. We have employed a new annealing oven for the annealing of CdTe-based solar cells and have been using this system in an attempt to grow US on top of CdTe by annealing in the presence of H2S gas. Preliminary results of this process on CdTe solar cells and other thin-film devices will be presented.
Author
*Annealing; Solar Cells; Thin Films*

**20020019037** Netherlands Energy Research Foundation, Petten, Netherlands
**Continuous SiN(x) Plasma Processing Using the Inline MW RPECVD (MicroWave Remote Plasma Enhanced Chemical Vapour Deposition) System**
Weeber, A. W.; Soppe, W. J.; Oct. 2001; 8p; In English; European Photovoltaic Solar Energy Conference (17th) and Exhibition, Munich, Germany, October 22-26, 2001; Prepared in cooperation with Freiburger Materialforschungszentrum
Report No.(s): PB2002-101663; ECN-RX-01-024; Copyright; Avail: National Technical Information Service (NTIS)

We investigated how long SiNx:H depositions can be performed continuously using the MicroWave Remote Plasma Enhanced Chemical Deposition (MW RPECVD) system at ECN without any cleaning or other interruption of the process. It has been shown that the system can be used for at least 20 hours without significant changes in properties of the deposited layers. The refractive index n and the extinction coefficient k at a wavelength of 630 nm do not change. Only the deposition rate increases slightly and that results in a somewhat thicker layer (less than 5% increase). The solar cell parameters remain constant or improve slightly in the course of time. Voc does not change within the experimental error and Jsc increases about 2%. This increase is caused by a better passivation at the front surface. Furthermore, a small reduction in red response is observed by this hardly affects Jsc. The observed changes might be caused by parasitic depositions that result in changes of the plasma conditions. It is still unclear how these changes in plasma conditions influence the passivating properties and the deposition rate.
NTIS
*Solar Cells; Vapor Deposition; Silicon Nitrides; Microwaves; Plasmas (Physics)*

**20020019038** Netherlands Energy Research Foundation, Petten, Netherlands
**Effect of Wafer Thickness on the Performance of mc-Si Solar Cells**
Tool, C. J. J.; Burgers, A. R.; Manshanden, P.; Weeber, A. W.; vanStraaten, B. H. M.; Oct. 2001; 8p; In English; 17th European

Photovoltaic Solar Energy Conference and Exhibition, October 22-26, 2001, Munich, Germany
Report No.(s): PB2002-101440; ECN-RX-01-23; Copyright; Avail: National Technical Information Service (NTIS)

The influence of the thickness of silicon solar cells has been investigated using neighboring multicrystalline silicon wafers with thickness ranging from 150 to 325 micrometers. It was found experimentally that n is nearly independent of the wafer thickness Jsc is nearly independent of the thickness due to a high internal reflectivity of the A1 rear metallization. A decrease in Jsc is observed only if the wafer thickness becomes less than about 200 micrometers. The weak dependence of Voc on the wafer thickness was well within the experimental error in this investigation. From PCID modelling it is concluded that n is limited by the rear surface passivation of the commonly used A1-BSF. Alternative rear surface passivation schemes should increase the solar cell performance significantly, but this has not yet been confirmed experimentally.

NTIS

*Solar Cells; Thickness; Wafers; Crystallinity; Performance Prediction*

**20020019041** Netherlands Energy Research Foundation, Petten, Netherlands

**Conductive Adhesives for Interconnection of Busbarless Emitter Wrap-Through Solar Cells on a Structured Metal Foil**

Eikelboom, D. W. K.; Burgers, A. R.; Goris, M. J. A. A.; Manshanden, P.; Schoenecker, A.; Oct. 2001; 8p; In English
Report No.(s): PB2002-101439; ECN-RX-01-016; Copyright; Avail: National Technical Information Service (NTIS)

The objective of this work was to make a 16% efficient screen-printed emitter wrap-through (EWT) solar module. For this purpose the busbars on the rear of the EWT cell were omitted, which maximises the useful cell area and the efficiency. The busbars' current collecting task is taken over by a special rear side interconnection foil on to which each metal finger is connected by conductive adhesives. This foil also serves as a rear side moisture barrier. In this paper the processing of busbarless EWT cells and the interconnection in a module are described with a special focus on the use of conductive adhesives. Busbarless EWT cells with an efficiency up to 15.6% have been processed and single cell laminates have successfully been made. Ongoing extensive climate tests have shown no significant degradation so far.

NTIS

*Adhesives; Emitters; Metal Foils; Solar Cells; Joining*

**20020019960** Netherlands Energy Research Foundation, Petten, Netherlands

**Theory and User Manual: BLADOPT**

Bulder, B. H.; Barhorst, S. A. M.; Schepers, J. G.; Hagg, F.; Sep. 2001; 98p; In English
Report No.(s): PB2002-101667; ECN-C-01-011; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

This document serves as the theory and user's manual of the computer program BLADOPT 1.0. The computer program BLADOPT is the successor of the PVOPT-1 program. The BLADOPT program is a numerical optimization computer program to design rotor blades for Horizontal Axis Wind Turbines. The program is able to vary the rotor design parameters like the chord and twist distributions in such a way that the cost of energy is minimized. Other parameters that can also be optimized are rotor diameter, rotor speed and the rated power, although not more than 10 parameters can be optimized at the same time. The main difference, for the user, with the program PVOPT is that the optimization objective is not optimum energy yield but lowest cost of energy. This implies that not only the energy yield is predicted but also the cost of the wind turbine components and the operation and maintenance costs are determined. For all necessary cost items a user supplied value or a cost function is implemented. Due to the multidisciplinary models, aerodynamic and cost/engineering models in the program the BLADOPT code can be categorized as a Multidisciplinary Design Optimization program. In this manual a short description can be found of the optimization schemes, the wind turbine model consisting of a description of the aerodynamic model, the cost functions, the noise model and the economic analysis. The user manual part contains a section on the installation of the program and the user interface.

NTIS

*Wind Turbines; Windpowered Generators; Turbine Blades; Computerized Simulation; Computer Aided Design; Cost Reduction*

**20020019961** Netherlands Energy Research Foundation, Petten, Netherlands

**Long-Term Stability of Dye-Sensitized Solar Cells for Large Area Power Applications: LOTS-DSC Publishable Report**

Kroon, J. M.; Hinsch, A.; vanRoosmalen, J. A. M.; vanderBurg, N. P. G.; Bakker, N. J.; Nov. 2001; 16p; In English
Report No.(s): PB2002-101666; ECN-C-01-124; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

In this three-year project the project partners have worked on the long-term stability and efficiency of nanocrystalline Dye-sensitized Solar Cells (nc-DSC). Accelerated aging tests on nc-DSC show that, to first order, a separation between the effects of the stress factors visible light soaking, UV (ultraviolet)-illumination and thermal treatment on the long-term stability can be made. The corresponding mechanisms are of electrochemical, photochemical and pure chemical nature respectively. It has been further proven that 2-valent salts like MgI2 and CaI2 as additives to the electrolyte have a strong stabilizing effect during

UV-illumination. Tests under continuous light soaking for several thousand hours demonstrate the ability of nc-DSCs to operate for at least five to ten years under outdoor illumination conditions without major degradations. Continuous and periodic thermal tests according to IECC 1215 norms are promising but with 30% to 40% loss in efficiency still critical.
NTIS
*Solar Cells; Stability*

## 45
## ENVIRONMENT POLLUTION

*Includes atmospheric, water, soil, noise, and thermal pollution.*

**20020016142** Federal Energy Technology Center, Morgantown, WV USA
**Advanced hybrid particulate collector**
Miller, S. J.; Schelkoph, G. L.; Dunham, G. E.; Dec. 01, 2000; 243p; In English
Report No.(s): DE2001-783187; AC22-95PC95258-15; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new concept in particulate control, called an advanced hybrid particulate collector (AHPC), is being developed under funding from the US Department of Energy. The AHPC combines the best features of electrostatic precipitators (ESPs) and baghouses in an entirely novel manner. The AHPC concept combines fabric filtration and electrostatic precipitation in the same housing, providing major synergism between the two methods, both in the particulate collection step and in transfer of dust to the hopper. The AHPC provides ultrahigh collection efficiency, overcoming the problem of excessive fine-particle emissions with conventional ESPs, and solves the problem of reentrainment and recollection of dust in conventional baghouses. Phase I of the development effort consisted of design, construction, and testing of a 5.7-m(sup 3)/min (200-acfm) working AHPC model. Results from both eight-hour parametric tests and 100-hour proof-of-concept tests with two different coals demonstrated excellent operability and greater than 99.99% fine-particle collection efficiency.
NTIS
*Electrostatic Precipitators; Precipitates; Dust Collectors*

**20020016236** National Renewable Energy Lab., Golden, CO USA
**Microalgae Production from Power Plant Flue Gas: Environmental Implications on a Life Cycle Basis**
Kadam, K. L.; Jun. 22, 2001; 63p; In English
Report No.(s): DE2001-783405; NREL/TP-510-29417; No Copyright; Avail: Department of Energy Information Bridge

Power-plant flue gas can serve as a source of CO2 for microalgae cultivation, and the algae can be cofired with coal. This life cycle assessment (LCA) compared the environmental impacts of electricity production via coal firing versus coal/algae cofiring. The LCA results demonstrated lower net values for the algae cofiring scenario for the following using the direct injection process (in which the flue gas is directly transported to the algae ponds): SOx, NOx, particulates, carbon dioxide, methane, and fossil energy consumption. Carbon monoxide, hydrocarbons emissions were statistically unchanged. Lower values for the algae cofiring scenario, when compared to the burning scenario, were observed for greenhouse potential and air acidification potential. However, impact assessment for depletion of natural resources and eutrophication potential showed much higher values. This LCA gives us an overall picture of impacts across different environmental boundaries, and hence, can help in the decision-making process for implementation of the algae scenario.
NTIS
*Algae; Microorganisms; Flue Gases; Environment Effects*

**20020016468** NASA Ames Research Center, Moffett Field, CA USA
**Monitoring Trace Contaminants in Air Via Ion Trap Mass Spectrometry**
Palmer, Peter T., NASA Ames Research Center, USA; Karr, Dane, NASA Ames Research Center, USA; Pearson, Richard, NASA Ames Research Center, USA; Valero, Gustavo, NASA Ames Research Center, USA; Wong, Carla, NASA Ames Research Center, USA; [1995]; 1p; In English; 1995 American Society for Mass Spectrometry Meeting, 21-25 May 1995, Atlanta, GA, USA
Contract(s)/Grant(s): RTOP 199-61-62-17; No Copyright; Avail: Issuing Activity; Abstract Only

Recent passage of the Clean Air Act with its stricter regulation of toxic gas emissions, and the ever-growing number of applications which require faster turnaround times between sampling and analysis are two major factors which are helping to drive the development of new instrument technologies for in-situ, on-line, real-time monitoring. The ion trap, with its small size, excellent sensitivity, and tandem mass spectrometry capability is a rapidly evolving technology which is well-suited for these

applications. In this paper, we describe the use of a commercial ion trap instrument for monitoring trace levels of chlorofluorocarbons (CFCs) and volatile organic compounds (VOCs) in air. A number of sample introduction devices including a direct transfer line interface, short column GC, and a cryotrapping interface are employed to achieve increasing levels of sensitivity. MS, MS/MS, and MS/MS/MS methods are compared to illustrate trade-offs between sensitivity and selectivity. Filtered Noise Field (FNF) technology is found to be an excellent means for achieving lower detection limits through selective storage of the ion(s) of interest during ionization. Figures of merit including typical sample sizes, detection limits, and response times are provided. The results indicate the potential of these techniques for atmospheric assessments, the High Speed Research Program, and advanced life support monitoring applications for NASA.
Author
*Air Quality; Detection; Exhaust Emission; Exhaust Gases; Real Time Operation; Toxicity; Trace Contaminants*

**20020016494** NASA Goddard Space Flight Center, Greenbelt, MD USA
**NASA's Living With a Star Program**
Poland, Arthur, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Solar Cycle and Space Weather Euroconference, 24-29 Sep. 2001, Naples, Italy; No Copyright; Avail: Issuing Activity; Abstract Only

Space Weather and the solar effects on Earth's climate are not only fascinating topics from a science viewpoint, but are of significant economic importance. The current SOHO and International Solar Terrestrial Physics Program (ISTP) are aimed at understanding the Sun and Earth system. These spacecraft have made significant progress in understanding Space Weather. Their success has led to the new Living With A Star initiative in NASA, I will show some of the results from SOHO and ISTP and discuss the new Living With A Star program, I will present some of the justifications for the program and discuss the fleet of spacecraft as currently envisioned.
Author
*Climate; Space Weather; Solar Activity*

**20020017478** Federal Energy Technology Center, Morgantown, WV USA
**Novel gas cleaning/conditioning for integrated gasification combined cycle**
Abbasian, J.; Jul. 01, 2001; 34p; In English
Report No.(s): DE2001-784578; AC26-99FT40674-01; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of this program is to develop and evaluate novel sorbents for the Siemens Westinghouse Power Company's (SWPC's) "Ultra-Clean Gas Cleaning Process" for reducing to near-zero levels the sulfur- and chlorine-containing gas emissions and fine particulate matter (PM2.5) caused by fuel bound constituents found in carbonaceous materials, which are processed in Integrated Gasification Combined Cycle (IGCC) technologies.
NTIS
*Sorbents; Desulfurizing; Carbonaceous Materials*

**20020017525** NASA Goddard Space Flight Center, Greenbelt, MD USA
**US Reanalysis for Climate and Chemistry Applications**
Rood, Richard B., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; ECMWF, 5-9 Nov. 2001, Reading, UK; No Copyright; Avail: Issuing Activity; Abstract Only

The Data Assimilation Office will perform a short reanalysis with its next-generation data assimilation system. This reanalysis will start a few months prior to the eruption of El Chichon and continue to real time. It will cover the entire time span of the Upper Atmospheric Research Satellite mission, and it is expected to be used in chemistry and climate applications. The sorts of improvements that are expected with this system and the status will be presented. In addition there has been a call in the USA for a National Reanalysis Project. This is envisioned as a sustained multi-agency activity coordinated (staggered) with the ECMWF reanalysis. The plans for the National Reanalysis Project will be discussed.
Author
*Climate; Weather Forecasting; Artificial Satellites; Data Systems; Atmospheric Chemistry*

**20020017970** Environmental Protection Agency, Atmospheric Research and Exposure Assessment Lab., Research Triangle Park, NC USA

**Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 5, Precipitation Measurement Systems (Interim Edition)**

Apr. 1994; 272p; In English

Report No.(s): PB2001-107700; EPA/600/R-94/038E; No Copyright; Avail: National Technical Information Service (NTIS)

Contents include the following: Overview of the Interim Edition of Volume V; Program Planning and Objectives; Program Organization and Responsibilities; Documentation; Sitting; Field Operations; Laboratory Operations; Data Handling, Validation, and Reporting; Data Quality Assessment; Acid Precipitation Monitoring Program Evaluation; Operation and Maintenance Procedures for Precipitation Measurement Systems.

NTIS

*Air Pollution; Handbooks; Quality Control; Precipitation (Meteorology)*

**20020018009** Center for Mathematics and Computer Science, Amsterdam Netherlands

**HPCN and Air Quality Modeling. Modelling, Analysis and Simulation**

Blom, J. G.; Lioen, W. M.; Verwer, J. G.; Jan. 1998; 22p; In English

Report No.(s): PB2001-108507; MAS-R9801; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

The authors discuss the implementation of an off-line air quality model (AQM). More precisely, how to design a code for an AQM that runs efficiently on a variety of computer platforms. The authors implemented their ideas in an AQM benchmark and they show the performance on the different architectural paradigms. A second subject of the paper is the I/O performance of the Cray T3E for an off-line model. The authors implemented the required I/O in different ways and show that none of these results in a truly scalable I/O.

NTIS

*Air Quality; Environment Models; Simulation*

**20020018012** Office of Air Quality Planning and Standards, Research Triangle Park, NC USA

**Industry Profile for the Proposed Wood Building Products NESHAP** ***Final Report***

Feb. 2001; 84p; In English

Report No.(s): PB2001-107701; EPA/453/R-01/002; No Copyright; Avail: National Technical Information Service (NTIS)

This industry profile is organized into four additional sections. In Section 2, the affected production process, inputs, outputs, and costs of production are described. Section 3 discusses industry organization, including market structure, manufacturing plants, and parent company characteristics. Section 4 describes the uses and consumers of wood building products. Finally, Section 5 provides market data on the wood building products industry, including market volumes, prices, and future outlook. While the industry profile focuses on the wood building products industry, information is also provided on the indirectly affected coatings industry.

NTIS

*Industries; Wood; Air Pollution; Market Research; Demand (Economics)*

**20020018013** Environmental Protection Agency, Atmospheric Research and Exposure Assessment Lab., Research Triangle Park, NC USA

**Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, Stationary Source-Specific Methods**

Sep. 1994; 474p; In English

Report No.(s): PB2001-107699; EPA/600/R-94/038C; No Copyright; Avail: National Technical Information Service (NTIS)

The Quality Assurance (QA) Handbook is comprised of five volumes: Volume 1 (Principles), Volume II (Ambient Air Methods), Volume III (Stationary Source Methods), Volume IV (Meteorological Measurements) and Volume V (Precipitation Measurement Systems). This volume of the QA Handbook recommends QA and QC procedures appropriate for approximately 60 EPA stationary source reference test methods and methods similar to them. This is likely the last version of this document published by the EPA Office of Research and Development.

NTIS

*Air Pollution; Handbooks; Quality Control; Precipitation (Meteorology)*

**20020018014** Environmental Protection Agency, Atmospheric Research and Exposure Assessment Lab., Research Triangle Park, NC USA

**Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 4, Meteorological Measurements (Revised August, 1989)**

Mar. 1995; 230p; In English

Report No.(s): PB2001-107698; EPA/600/R-94/038D; No Copyright; Avail: National Technical Information Service (NTIS)

The Quality Assurance (QA) Handbook is comprised of five volumes: Volume I (Principles), Volume II (Ambient Air Methods), Volume III (Stationary Source Methods), Volume IV (Meteorological Measurements) and Volume V (Precipitation Measurement Systems). This volume of the QA Handbook recommends QA and QC procedures appropriate to meteorological measurement systems, including ground-based remote profilers such as Doppler Sodars, Doppler Radars, and Radio Acoustic Sounding Systems (RASS). This is likely to be the last version of this document published by the EPA Office of Research and Development.

NTIS

*Air Pollution; Handbooks; Precipitation (Meteorology); Quality Control; Data Acquisition; Meteorological Instruments*

**20020018015** Environmental Protection Agency, Atmospheric Research and Exposure Assessment Lab., Research Triangle Park, NC USA

**Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 1, A Field Guide to Environmental Quality Quality Assurance**

Nees, M.; 1993; 56p; In English

Report No.(s): PB2001-107697; EPA/600/R-94/038A; No Copyright; Avail: National Technical Information Service (NTIS)

The Quality Assurance (QA) Handbook is comprised of five volumes: Volume 1 (Principles), Volume II (Ambient Air Methods), Volume III (Stationary Source Methods), Volume IV (Meteorological Measurements) and Volume V (Precipitation Measurement Systems). This volume of the QA Handbook was prepared to provide the air monitoring community an overview of QA principles and practices and guidance on applying them to air monitoring measurement systems. This is likely the last version of this document published by the EPA Office of Research and Development.

NTIS

*Air Pollution; Environmental Monitoring; Handbooks; Quality Control; Precipitation (Meteorology)*

**20020018017** Midwest Research Inst., Kansas City, MO USA

**Particulate Emission Measurements from Controlled Construction Activities** ***Final Report, Apr. 1999 - Feb. 00***

Muleski, G. E.; Cowherd, C.; Apr. 2001; 176p; In English

Report No.(s): PB2001-107255; EPA/600/R-01/031; No Copyright; Avail: National Technical Information Service (NTIS)

The report summarizes the results of field testing of the effectiveness of control measures for sources of fugitive particulate emissions found at construction sites. The effectiveness of watering temporary unpaved travel surfaces on emissions of particulate matter with aerodynamic diameters of less than 10 micrometers (PM-10) was tested in Beloit, Kansas, during September 1999. The tested operation was scraper transit. The effectiveness of paved and graveled access aprons on mud/dirt trackout from unpaved truck exit routes was tested in Grandview, Missouri, during November 1999. In the latter tests, moisture content and soil type were varied to determine if watering of exit routes, while reducing on-site emissions, might offset the effect of increasing emissions attributable to in-place mud/dirt trackout controls.

NTIS

*Field Tests; Particulates; Exhaust Emission; Control Theory; Construction Industry*

**20020018018** Georgia Tech Research Inst., Electro-Optics Environment and Materials Lab., Atlanta, GA USA

**Application of Pollution Prevention Techniques to Reduce Indoor Air Emissions from Aerosol Consumer Products** ***Final Report, Jul. 1994 - Sep. 1997***

Bayer, C. W.; Browner, R. A.; Ho, S.; Christianson, L. L.; Zhao, L. Y.; Jun. 2001; 88p; In English

Report No.(s): PB2001-107254; EPA/600/R-01/039; No Copyright; Avail: National Technical Information Service (NTIS)

The report gives results of a research project to develop tools and methodologies to measure aerosol chemical and particle dispersion through space. These tools can be used to devise pollution prevention strategies that could reduce occupant chemical exposures and guide manufacturers in formulating more efficacious products. The researchers built an Aerosol Mass Spectral Interface (AMSI), which is interfaced with a mass spectrometer (MS), that chemically characterizes aerosol consumer products as they move through space. They also developed techniques for measuring aerosol movement indoors by tracking particle size changes via particle velocity measurements using particle image velocimetry (PIV). The AMSI was designed, constructed, and

optimized to transfer a focused beam of aerosol particles into a MS for chemical analysis. Experiments showed that the AMSI can quantitatively detect compositional changes as the aerosol moves through space. These data provide important information for formulating aerosol consumer products for pollution prevention strategies. The PIV system demonstrated a correlation between the material properties of the aerosol components and the spray patterns. The model can be used to help develop pollution prevention strategies.
NTIS
*Aerosols; Pollution Control; Indoor Air Pollution; Chemical Analysis; Consumers*

**20020018053** Naval Sea Systems Command, Washington, DC USA
**Environmental Analytical Measurement Uncertainty Estimation, Nested Hierarchical Approach**
Ingersoll, William S.; Jan. 2001; 57p; In English
Report No.(s): AD-A396946; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This document provides guidance for estimating environmental analytical measurement uncertainty. Each year billions of dollars are expended to generate environmental study data. These data are used in programs to protect the environment and mitigate environmental impacts. The quality of these data affect environmental cleanup, compliance, and ambient monitoring decision-making. To provide data of known quality, sampling and analysis plans are developed to accurately and precisely represent the contaminant distribution parameters of an environmental site or population. Associated with the environmental study data is the estimated measurement uncertainty that results from the sampling and analysis process. This measurement uncertainty affects environmental study data quality. The process of making decisions under uncertainty is a challenge for environmental decision-makers. Decision-makers must assess the effects of measurement uncertainty on environmental decisions. While the possibility of a decision error can never be totally eliminated, it can be controlled. to control decision errors, the measurement uncertainty must be controlled.
DTIC
*Estimates; Environmental Cleanup; Contaminants*

**20020018150** General Accounting Office, Washington, DC USA
**Environmental Protection: Federal Incentives Could Help Promote Land Use That Protects Air and Water Quality. Report to Congressional Requesters**
Oct. 2001; 175p; In English
Report No.(s): AD-A396866; GAO-02-12; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This report discusses the extent to which possible environmental effects from land use and development patterns (including patterns commonly known as urban sprawl) are taken into account in transportation, air quality protection, and water quality protection efforts. This report contains recommendations to the Secretary of Transportation and the Administrator of the Environmental Protection Agency (EPA). The recommendations address ways that the agencies can provide states and localities with financial incentives and technical support, among other things, to help them give greater consideration to the environmental impacts of their land use decisions.
DTIC
*Air Quality; Environment Protection; Land Use; Water Quality*

**20020018186** Atomic Energy Commission, Hanford Operations Office, Washington, DC USA
**Environmental Control Plan for the Industrial Hygiene Field Services Facility**
Donnelly, J. W.; Aug. 29, 2001; 21p; In English
Report No.(s): DE2001-787539; BHI-01408-Rev-1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This environmental control plan is for the Hanford Site's industrial hygiene field services facility, located in the 100-N Area. The facility is used for the maintenance and storage of respirators, respiratory equipment and testing, calibration and testing of industrial hygiene equipment, and asbestos fiber counting.
NTIS
*Environmental Control; Breathing Apparatus; Industrial Safety; Inventory Management*

**20020018822** Environmental Protection Agency, Air Pollution Prevention and Control Div., Research Triangle Park, NC USA
**Pilot-Scale Studies on the Effect of Bromine Addition on the Emissions of Chlorinated Organic Combustion By-products**
Lemieux, P. M.; Stewart, E. S.; Ryan, J. V.; 2001; 14p; In English; International Conference on Incineration and Thermal Treatment Technologies 2001, May 14-18, 2001
Report No.(s): PB2001-108002; EPA/600/A-01/047; No Copyright; Avail: National Technical Information Service (NTIS)

The paper reports on a study to evaluate organic combustion by-product emissions while feeding varying amounts of bromine (Br) and chlorine (Cl) into a pilot-scale incinerator burning surrogate waste materials. Adding brominated organic compounds to a pilot-scale incinerator burning chlorinated waste has been found to enhance emissions of volatile and semivolatile organic chlorinated products of incomplete combustion (PICs) including polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs/Fs). This phenomenon appears to be sensitive to temperature and combustion conditions. The surrogate waste was fed at a constant molar halogen input rate, with varying Br/Cl molar ratios. An increase in the total PCDD/F concentration due to the addition of Br was not observed consistently. PCDD/F homologue distribution shifted toward the higher chlorinated species. Perhalogenated or nearly perhalogenated mixed Br/Cl dioxins and furans were also observed.
NTIS
*Air Pollution; Bromine Compounds; Combustion Products; Pollution Control*

**20020018847** National Health and Environmental Effects Research Lab., Western Ecology Div., Corvallis, OR USA
**Ozone and Natural Systems: Understanding Exposure, Response, and Risk**
Laurence, J. A.; Thompson, B.; Andersen, C. P.; Apr. 10, 2001; 26p; In English
Report No.(s): PB2001-107713; EPA/600/A-01/048; No Copyright; Avail: National Technical Information Service (NTIS)
Research aimed at understanding the response of plants to ozone has been conducted for over four decades but little of it has addressed intact natural systems. Even so, there is sufficient scientific information at this time to support air quality standards that will protect natural terrestrial ecosystems from ozone. What is unknown is the risk associated with continued exposure of natural systems, including both above-ground and below-ground components, in combination with other stresses including changing temperature and precipitation, elevated carbon dioxide, pests and pathogens, invasive species, and other activities that may fragment the landscape. Research to support an assessment of the ecological risk associated with ozone as it exists, in a milieu of stresses, must include endpoints beyond those addressed in the past, primarily productivity and species composition. to estimate the risk to society of ozone impacts on natural systems, endpoints such as the integrity of soil food webs, the quantity and quality of water supplied from terrestrial ecosystems, wildlife and recreational values, and the transfer and fate of carbon, nutrients, and water within the systems must be quantified. Not only will this research provide the basis for a sound estimate of risk, but also it will improve our understanding of fundamental ecosystem processes.
NTIS
*Ozone; Air Pollution; Ecosystems; Environment Effects; Plants (Botany)*

**20020018848** Syracuse Univ., Dept. of Mechanical, Aerospace and Manufacturing Engineering, NY USA
**Guide for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products**
Zhang, J.; Mason, M.; Jun. 18, 2001; 50p; In English
Report No.(s): PB2001-107714; No Copyright; Avail: National Technical Information Service (NTIS)
The practice is intended for determining volatile organic compound (VOC) emissions from materials and products (building materials, material systems, furniture, consumer products, etc.) and equipment (printers, photocopiers, air cleaners, etc.) under environmental and product-usage conditions typical of those in office and residential buildings. It is for identifying VOCs emitted and determining their emission rates. It describes the design, construction, performance evaluation, and use of full-scale chambers for VOC emission testing. While limited to measuring VOC emissions, many of its general principles and procedures (e.g., methods for evaluating the general performance of the chamber system) may also be useful for determining other chemical emissions (e.g., ozone, nitrogen dioxide). Materials or products are placed in a full-scale test chamber within which temperature, relative humidity, and air change are controlled.
NTIS
*Indoor Air Pollution; Pollution Control; Volatile Organic Compounds*

**20020018849** Environmental Protection Agency, National Exposure Research Lab., Las Vegas, NV USA
**Mountain Acid Deposition Program (MADPro): Cloud Deposition to the Appalachian Mountains, 1994 through 1999**
Isil, S. S.; Lavery, T. L.; Baumgardner, R. E.; Dec. 2000; 220p; In English
Report No.(s): PB2001-107715; NERL-LV-ESD-01-020; No Copyright; Avail: National Technical Information Service (NTIS)
The Mountain Acid Deposition Program (MADPro) was initiated in 1993 as part of the research necessary to support the objectives of the Clean Air Status and Trends Network (CASTNet), which was created to address the requirements of the Clean Air Act Amendments (CAAA). The two main objectives of MADPro were to develop cloud water measurement systems to be used in a network monitoring environment and to update the cloudwater concentration and deposition data collected in the Appalachian Mountains during the National Acid Precipitation Assessment Program (NAPAP) at three permanent mountaintop sampling stations. These sampling stations were located at Whiteface Mountain, New York; Clingman's Dome, Tennessee; and

Whitetop Mountain, Virginia. A mobile manual sampling station was also operated at two locations in the Catskill Mountains in New York during 1995, 1997, and 1998.
NTIS
*Air Pollution; Atmospheric Models; Clouds (Meteorology); Appalachian Mountains (North America); Air Quality; Pollution Control; Acid Rain; Environmental Monitoring*

**20020018852** Environmental Protection Agency, Air Pollution Prevention and Control Div., Research Triangle Park, NC USA
**Diesel NO(x) Control Application**
Wasser, J. H.; Lee, S. Y.; 2001; 14p; In English; Presented at AFRC Meeting, Research Triangle Park, NC, April 23, 2001
Report No.(s): PB2001-108004; EPA/600/A-01/046; No Copyright; Avail: National Technical Information Service (NTIS)
The paper gives results of a project to design, develop, and demonstrate a diesel engine nitrogen oxide (NO-x) and particulate matter (PM) control package that will meet the U.S. Navy's emission control requirements. (NOTE: In 1994, EPA (Environmental Protection Agency) issued a Notice for Proposed Rule Making (NPRM) addressing emissions from marine engines, including diesel engines. The proposed standards for diesel engines include: 9.2 g/kWh for No-x, 11.4 g/kWh for carbon monoxide (CO), and 0.54 g/kWh for PM.) A combination of engine timing retard, external exhaust gas recirculation, and an oxidizer reduced NO-x and CO emissions to the level recommended by the proposed EPA standard, while PM emissions remained unchanged in a test engine for a wide range of operating conditions. A shipboard test showed similar reduction of No-x and CO without reducing fuel efficiency or the performance of the propulsion engine. This may represent one of the most cost effective methods to retrofit the Navy's diesel engines to meet future emission standards.
NTIS
*Air Pollution; Nitrogen Oxides; Diesel Engines; Pollution Control*

**20020018869** Massachusetts Inst. of Tech., Dept. of Earth, Atmospheric and Planetary Science, Cambridge, MA USA
**Advanced Global Atmospheric Gases Experiment (AGAGE)**
Prinn, Ronald G., Massachusetts Inst. of Tech., USA; [2001]; 12p; In English
Contract(s)/Grant(s): NAG5-3974; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
AGAGE comprises continuous high frequency in-situ gas chromatographic FID/ECD measurements of two biogenic/anthropogenic gases (CH4, N2O) and five anthropogenic gases (CFCl3, CF2Cl2, CH3CCl3, CF2ClCFCl2, CCl4) which are carried out at five globally distributed sites (Ireland, California, Barbados, Samoa, Tasmania). Also, high frequency in-situ gas-chromatographic mass spectrometric measurements of about 30 species including chlorofluorocarbon replacements and many natural halocarbons are made at two sites (Ireland, Tasmania), and will soon begin at the other three sites. Finally, high frequency in-situ gas chromatographic HgO-RD measurements of CO and H2 are performed at two sites (Ireland, Tasmania). The goal is quantitative determination of the sources, sinks, and circulation of these environmentally important gases.
Author
*Atmospheric Composition; Gas Chromatography; Methane; Nitrogen Oxides; Mass Spectroscopy; Chlorofluorocarbons*

**20020020435** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Ensemble Cannonical Correlation Prediction of Seasonal Precipitation Over the US**
Lau, William K. M., NASA Goddard Space Flight Center, USA; Kim, Kyu-Myong, NASA Goddard Space Flight Center, USA; Shen, Samuel, Alberta Univ., Canada; [2001]; 1p; In English; 26th Annual Climate Diagnostics and Prediction Workshop, 22-26 Oct. 2001, LaJolla, CA, USA; No Copyright; Avail: Issuing Activity; Abstract Only
This paper presents preliminary results of an ensemble cannonical correlation (ECC) prediction scheme developed at the Climate and Radiation Branch, NASA/Goddard Space Flight Center for determining the potential predictability of regional precipitation, and for climate downscaling studies. The scheme is tested on seasonal hindcasts of anomalous precipitation over the continental USA using global sea surface temperature (SST) for 1951-2000. to maximize the forecast skill derived from SST, the world ocean is divided into nonoverlapping sectors. The cannonical SST modes for each sector are used as the predictor for the ensemble hindcasts. Results show that the ECC yields a substantial (10-25%) increase in prediction skills for all regions of the US and for all seasonal compared to traditional CCA prediction schemes. For the boreal winter, the tropical Pacific contributes the largest potential predictability to precipitation in the southwestern and southeastern regions, while the North Pacific and the North Atlantic are responsible for enhanced forecast skills in the Pacific Northwest, the northern Great Plains and Ohio Valley. Most importantly, the ECC increases skill for summertime precipitation prediction and substantially reduced the spring predictability barrier over all regions of the US continent. Besides SST, the ECC is designed with the flexibility to include any number of predictor fields, such as soil moisture, snow cover and regional regional data. Moreover, the ECC forecasts can be applied to other climate subsystems and, in conjunction with further diagnostic or model studies will enables a better

understanding of the dynamic links between climate variations and precipitation, not only for the US, but also for other regions of the world.
Author
*Precipitation (Meteorology); Climate Change; Sea Surface Temperature; Weather Forecasting; Annual Variations*

**20020020441** NASA Goddard Space Flight Center, Greenbelt, MD USA
**An Assessment of the Ability of Potential Space-Borne Instruments to Resolve Spatial and Temporal Variability of Atmospheric Carbon Dioxide**
Andrews, Arlyn E., NASA Goddard Space Flight Center, USA; Kawa, S. Randolph, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; 6th International Carbon Dioxide Conference, 1-5 Oct. 2001, Sendai, Japan; No Copyright; Avail: Issuing Activity; Abstract Only

Mounting concern regarding the possibility that increasing carbon dioxide concentrations will initiate climate change has stimulated interest in the feasibility of measuring CO2 mixing ratios from satellites. Currently, the most comprehensive set of atmospheric CO2 data is from the NOAA CMDL cooperative air sampling network, consisting of more than 40 sites where flasks of air are collected approximately weekly. Sporadic observations in the troposphere and stratosphere from airborne in situ and flask samplers are also available. Although the surface network is extensive, there is a dearth of data in the Southern Hemisphere and most of the stations were intentionally placed in remote areas, far from major sources. Sufficiently precise satellite observations with adequate spatial and temporal resolution would substantially increase our knowledge of the atmospheric CO2 distribution and would undoubtedly lead to improved understanding of the global carbon budget. We use a 3-D chemical transport model to investigate the ability of potential satellite instruments with a variety of orbits, horizontal resolution and vertical weighting functions to capture the variation in the modeled CO2 fields. The model is driven by analyzed winds from the Goddard Data Assimilation Office. Simulated CO2 fields are compared with existing surface and aircraft data, and the effects of the model convection scheme and representation of the planetary boundary layer are considered.
Author
*Atmospheric Composition; Carbon Dioxide Concentration; Satellite-Borne Instruments; Spatial Distribution; Three Dimensional Models; Temporal Distribution; Troposphere*

**20020020444** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Evaluation of Tropical Transport in a Global Chemistry and Transport Model**
Douglass, Anne R., NASA Goddard Space Flight Center, USA; DaSilva, A. M., NASA Goddard Space Flight Center, USA; Lin, S.-J., NASA Goddard Space Flight Center, USA; Pawson, S., NASA Goddard Space Flight Center, USA; Rood, R. B., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; 2001 Fall AGU Meeting, 10-14 Dec. 2001, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Observations of constituents from satellite, aircraft and sondes can be utilized to develop diagnostics of various aspects of tropical transport. These include tropical mid-latitude isolation, the seasonal transport from the upper tropical troposphere to the mid-latitude lowermost stratosphere, the seasonal cycle of the tropical total ozone and its variability. These diagnostics will be applied to constituent fields from an off-line chemistry and transport model (CTM) driven by winds from two sources. These are the Finite Volume Community Climate Model (FV-CCM), a general circulation model that uses the NCAR CCM physics and the Lin and Rood dynamical core, and an assimilation system developed by the Data Assimilation Office at the Goddard Space Flight Center that uses the FV-CCM at its core. Signatures of the quasi-biennial oscillation present in the observations will be emphasized to understand differences between the two model transports and the transport inferred from the observations.
Author
*Climate Models; Tropical Regions; Troposphere; Annual Variations; Atmospheric General Circulation Models; Observation*

**20020020964** Office of Air Quality Planning and Standards, Research Triangle Park, NC USA
**Quality Assurance Report, Calendar Year 2000: The SLAMS (State and Local Air Monitoring Network) PM(sub 2.5) Ambient Air Monitoring Program**
Nov. 2001; 296p; In English
Report No.(s): PB2002-101317; EPA/454/R-01/013; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

This report documents the quality assurance activities that were undertaken for the SLAMS PM2.5 environmental data operations for the calendar year January 1, 2000 to December 31, 2000 (CY00), which was the second year of implementation

of the PM2.5 monitoring program. The QA Report evaluates the adherence to the quality assurance requirements described in 40 CFR 58 App. A and evaluates the data quality indicators of precision, accuracy, bias, and completeness.
NTIS
*Air Quality; Air Sampling; Environmental Monitoring; Quality Control*

**20020021239** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Water Vapor Tracers as Diagnostics of the Regional Hydrologic Cycle**
Bosilovich, Michael G., NASA Goddard Space Flight Center, USA; Schubert, Siegfried D., NASA Goddard Space Flight Center, USA; [2001]; 48p; In English; Sponsored in part by the North America: the GEWEX Continental-Scale International Project (GCIP) and the Pan American Climate Studies (PACS) program; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Numerous studies suggest that local feedback of surface evaporation on precipitation, or recycling, is a significant source of water for precipitation. Quantitative results on the exact amount of recycling have been difficult to obtain in view of the inherent limitations of diagnostic recycling calculations. The current study describes a calculation of the amount of local and remote geographic sources of surface evaporation for precipitation, based on the implementation of three-dimensional constituent tracers of regional water vapor sources (termed water vapor tracers, WVT) in a general circulation model. The major limitation on the accuracy of the recycling estimates is the veracity of the numerically simulated hydrological cycle, though we note that this approach can also be implemented within the context of a data assimilation system. In the WVT approach, each tracer is associated with an evaporative source region for a prognostic three-dimensional variable that represents a partial amount of the total atmospheric water vapor. The physical processes that act on a WVT are determined in proportion to those that act on the model's prognostic water vapor. In this way, the local and remote sources of water for precipitation can be predicted within the model simulation, and can be validated against the model's prognostic water vapor. As a demonstration of the method, the regional hydrologic cycles for North America and India are evaluated for six summers (June, July and August) of model simulation. More than 50% of the precipitation in the Midwestern USA came from continental regional sources, and the local source was the largest of the regional tracers (14%). The Gulf of Mexico and Atlantic regions contributed 18% of the water for Midwestern precipitation, but further analysis suggests that the greater region of the Tropical Atlantic Ocean may also contribute significantly. In most North American continental regions, the local source of precipitation is correlated with total precipitation. There is a general positive correlation between local evaporation and local precipitation, but it can be weaker because large evaporation can occur when precipitation is inhibited. In India, the local source of precipitation is a small percentage of the precipitation owing to the dominance of the atmospheric transport of oceanic water. The southern Indian Ocean provides a key source of water for both the Indian continent and the Sahelian region.
Author
*Atmospheric Moisture; Evaporation; Hydrological Cycle; Recycling; Water Vapor*

## 46
## GEOPHYSICS

*Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see 47 Meteorology and Climatology; and 93 Space Radiation.*

**20020016087** Stevens Inst. of Tech., Dept. of Physics and Engineering Physics, Hoboken, NJ USA
**Assessment of the Contribution of the Atmosphere to Uncertainties in Normalized Water-Leaving Radiance: A Combined Modeling and Data Analysis Approach, Chapter 21**
Stamnes, Knut, Stevens Inst. of Tech., USA; Li, Wei, Stevens Inst. of Tech., USA; Chen, Bing-Quan, Stevens Inst. of Tech., USA; SIMBIOS Project; January 2001, pp. 146-148; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97138; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Our research for the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) program has been focused on modeling and simulation studies as well as the development of atmospheric correction algorithms. Based on our original proposal and discussions at the SIMBIOS team meetings and workshops, the objectives of our research can be summarized as follows: (1) Use our radiative transfer model for the coupled atmosphere-ocean system to simulate the radiation field at arbitrary levels and in any desired direction in the atmosphere and ocean so as to provide a firm connection between the signal received by the satellite sensor and by a sensor looking down into the water column just above the surface and just below it; (2) Use the simulations to quantify the influence of atmospheric aerosols on the water-leaving radiance, and to quantify the error in the water-leaving radiance as a function of uncertainties in the aerosol optical properties, mass loading and vertical extent; (3) Use the model simulations in conjunction with validation measurements taken by other SIMBIOS investigators (for satellite

overpasses) to assess our understanding of the radiative transfer process in the coupled atmosphere-ocean column, and to examine the extent to which the model provides a realistic prediction of simultaneously measured in situ water-leaving radiance and the radiance received by the satellite sensor; (4) Modify and improve an existing atmospheric correction algorithm, based on the work above, as needed by constructing new look-up tables that include scattering by ocean particles; and (5) Carry out approaches to developing an atmospheric correction algorithm for ocean color imagery with strongly absorbing aerosols.
Author
*Algorithms; Radiance; Computerized Simulation; Atmospheric Correction; Air Water Interactions*

**20020017520** Florida State Univ., Dept. of Mathematics, Tallahassee, FL USA
**Numerical Simulation of Screech Tones from Supersonic Jets: Physics and Prediction** ***Final Report***
Tam, Christopher K. W., Florida State Univ., USA; [2002]; 3p; In English
Contract(s)/Grant(s): NAG3-2102; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objectives of this project are to: (1) perform a numerical simulation of the jet screech phenomenon; and (2) use the data of the simulations to obtain a better understanding of the physics of jet screech. The original grant period was for three years. This was extended at no cost for an extra year to allow the principal investigator time to publish the results. We would like to report that our research work and results (supported by this grant) have fulfilled both objectives of the grant. The following is a summary of the important accomplishments: (1) We have now demonstrated that it is possible to perform accurate numerical simulations of the jet screech phenomenon. Both the axisymmetric case and the fully three-dimensional case were carried out successfully. It is worthwhile to note that this is the first time the screech tone phenomenon has been successfully simulated numerically; (2) All four screech modes were reproduced in the simulation. The computed screech frequencies and intensities were in good agreement with the NASA Langley Research Center data; (3) The staging phenomenon was reproduced in the simulation; (4) The effects of nozzle lip thickness and jet temperature were studied. Simulated tone frequencies at various nozzle lip thickness and jet temperature were found to agree well with experiments; (5) The simulated data were used to explain, for the first time, why there are two axisymmetric screech modes and two helical/flapping screech modes; (6) The simulated data were used to show that when two tones are observed, they co-exist rather than switching from one mode to the other, back and forth, as some previous investigators have suggested; and (7) Some resources of the grant were used to support the development of new computational aeroacoustics (CAA) methodology. (Our screech tone simulations have benefited because of the availability of these improved methods.)
Author
*Aeroacoustics; Computerized Simulation; Screech Tones*

**20020017755** Smithsonian Astrophysical Observatory, Cambridge, MA USA
**Large Scale Deformation of the Western US Cordillera** ***Annual Report, 15 Feb. 2001 - 14 Feb. 2002***
Bennett, Richard A., Smithsonian Astrophysical Observatory, USA; January 2002; 8p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG5-8226; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Destructive earthquakes occur throughout the western US Cordillera (WUSC), not just within the San Andreas fault zone. But because we do not understand the present-day large-scale deformations of the crust throughout the WUSC, our ability to assess the potential for seismic hazards in this region remains severely limited. to address this problem, we are using a large collection of Global Positioning System (GPS) networks which spans the WUSC to precisely quantify present-day large-scale crustal deformations in a single uniform reference frame. Our work can roughly be divided into an analysis of the GPS observations to infer the deformation field across and within the entire plate boundary zone and an investigation of the implications of this deformation field regarding plate boundary dynamics.
Author
*Earth Crust; Deformation; Global Positioning System; Plates (Tectonics); Monitors*

**20020019411** Michigan Technological Univ., Dept. of Electrical Engineering, Houghton, MI USA
**Experimental Investigation of Upper Turbulence Models** ***Final Report, 1 Jan. 1999-30 Nov. 2001***
Roggemann, Michael; Nov. 30, 2001; 7p; In English
Contract(s)/Grant(s): F49620-99-1-0088
Report No.(s): AD-A397199; AFRL-SR-BL-TR-01-0607; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Theoretical investigation of estimating turbulence statistical parameters from balloon-borne anemometer array measurements. The goal of this task is to develop the theoretical and computer modeling tools needed to investigate the turbulence strength, the isotropic nature of the turbulence, and the spatial correlation properties of the turbulence, or equivalently the spatial

power spectral density, of the index of refraction fluctuations in the upper atmosphere using balloon borne anemometer measurements as the input. Balloon borne experiment design, construction, and test. In this task we are designing, constructing, and testing a balloon-borne anemometer system which will measure atmospheric turbulence based on temperature data, allowing the theoretical investigations described in Task I to be tested with experimental data. Experimental campaigns and data reduction: The goal of this task is to conduct a very limited number of data collection campaigns at a variety of locations and times of day. The purpose of these tests is not to establish a world wide data base, but rather to demonstrate that there are quantifiable differences between data collected without any assumptions, and the present data.
DTIC
*Anemometers; Turbulence Models; Upper Atmosphere; Atmospheric Turbulence; Balloon-Borne Instruments*

**20020019413** Army Research Lab., Computational and Information Science Directorate, White Sands Missile Range, NM USA
**Turbulence Simulation: On Phase and Deflector Screen Generation**
Tofsted, David H.; Oct. 2001; 68p; In English
Report No.(s): AD-A397150; ARL-TR-1886; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This report examines the topic of phase screen generation and introduces an alternative method of modeling propagation through turbulence based on an extended raytrace method involving passage through three-dimensionally varying refractive turbulence. The mathematics of propagation through turbulence are thoroughly detailed, including several derivations often left as exercises for the reader in other documentation. Chapter 2 contains an analysis of the interrelationships between Fourier transforms, Fourier series, and Fast Fourier Transform (FFT) methods. These methods are used in chapter 3 to describe means of transforming between common mathematical forms of turbulence spectra used in the literature and standard engineering forms for employing FFTs. Chapter 4 concludes with an analysis of phase screen and deflector screen generation and usage.
DTIC
*Deflectors; Computerized Simulation; Mathematical Models; Turbulence; Propagation*

**20020019807** Oregon State Univ., Corvallis, OR USA
**Turbulence off the Coast of Oregon: A Large-Eddy Simulation Study. Modeling of the Atmospheric Circulation in the Santa Barbara Channel** ***Final Report, 1 Dec. 1997-31 Oct. 2001***
Skyllingstad, Eric D.; Wijesekera, Hemantha; Dec. 10, 2001; 2p; In English
Contract(s)/Grant(s): N00014-98-1-0113
Report No.(s): AD-A397187; N0108A; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
Two projects were completed under this grant. The first project examined how coastal terrain interacts with prevailing winds along the southern California coastline. We determined that under northwest flow, wind fields followed a systematic pattern governed by basic hydraulic flow theory. Land surface heating disrupted this pattern during the night by forcing an offshore flow, thereby creating regions of weak winds over the Santa Barbara Channel. Our second project examined how turbulence is forced in the coastal ocean. We utilized a large-eddy simulation model to examine how turbulence is forced by current motions over bottom terrain features and by frontal zones. Model results show that relatively small bottom features can drive large internal wave momentum flux, forcing a current drag that does not rely on active turbulence and is therefore not present in current turbulence parameterizations. We evaluated a set of three turbulence parameterizations in a coastal ocean model and determined that each model produced consistent results except near frontal zones during down welling events.
DTIC
*Atmospheric Circulation; Large Eddy Simulation; Turbulence; Oregon; Ocean Models; Wind (Meteorology); Coasts*

**20020019963** NASA Marshall Space Flight Center, Huntsville, AL USA
**Use of Yohkoh SXT in Measuring the Net Current and CME Productivity of Active Regions**
Falconer, D. A., Alabama Univ., USA; Moore, R. L., NASA Marshall Space Flight Center, USA; Gary, G. A., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; Multi-wavelength Observations of Coronal Structures and Dynamics-Yohkoh 10th Anniversary, 21-24 Jan. 2002, Kona, HI, USA; No Copyright; Avail: Issuing Activity; Abstract Only
In our investigation of the correlation of global nonpotentiality of active regions to their CME productivity (Falconer, D.A. 2001, JGR, in press, and Falconer, Moore, & Gary, 2000, EOS 82, 20 S323), we use Yohkoh SXT images for two purposes. The first use is to help resolve the 180 degree ambiguity in the direction of the observed transverse magnetic field. Resolution of the 180 degree ambiguity is important, since the net current, one of our measures of global nonpotentiality, is derived from integrating the dot product of the transverse field around a contour (I(sub N)=(integral)BT(raised dot)dl). The ambiguity results from the observed transverse field being determined from the linear polarization, which gives the plane of the direction, but leaves a 180 degrees ambiguity. Automated methods to resolve the ambiguity ranging from the simple acute angle rule (Falconer, D.A. 2001)

to the more sophisticated annealing method (Metcalf T.R. 1994). For many active regions, especially ones that are nearly potential these methods work well. But for very nonpotential active regions where the shear angle (the angle between the observed and potential transverse field) is near 90 degrees throughout large swaths along the main neutral line, both methods can resolve the ambiguity incorrectly for long segments of the neutral line. by determining from coronal images, such as those from Yohkoh/SXT, the sense of shear along the main neutral line in the active region, these cases can be identified and corrected by a modification of the acute angle rule described here. The second use of Yohkoh/SXT in this study is to check for the cusped coronal arcades of long-duration eruptive flares. This signature is an excellent proxy for CMEs, and was used by Canfield, Hudson, and McKenzie (1999 GRL V26, 6, 627-630). This work is funded by NSF through the Space Weather Program and by NASA through the Solar Physics Supporting Research and Technology Program.
Author
*Coronal Mass Ejection; Solar Physics; Automatic Control; X Ray Telescopes; Active Galaxies; Magnetic Fields*

**20020020425** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Stratospheric Age Spectra and Mean Ages from In Situ Observations of Carbon Dioxide**
Andrews, Arlyn E., NASA Goddard Space Flight Center, USA; Boering, Kristie A., California Univ., USA; Daube, Bruce C., Jr., Harvard Univ., USA; Wofsy, Steven C., Harvard Univ., USA; [2001]; 1p; In English; 6th International Carbon Dioxide Conference, 1-5 Oct. 2001, Sendai, Japan; No Copyright; Avail: Issuing Activity; Abstract Only

In situ observations of CO2 obtained from 1992 through 2000 using the NASA ER-2 aircraft and high-altitude balloons show that seasonal and interannual variations in CO2 mixing ratios propagate from the troposphere into the lower stratosphere via the tropical tropopause, along with the long-term trend due to fossil fuel combustion. These signals spread laterally and vertically, providing detailed quantitative information about the transport history of sampled air. We have used these data to derive age spectra and mean ages that can be compared with results from models of the stratospheric circulation. For an air parcel at a point in the stratosphere, the age spectrum is defined as the probability distribution function for transit times from the tropical tropopause for each fluid element comprising the parcel. The mean age is the average transit time, corresponding to the first moment of the age spectrum. Age spectra have been derived for altitudes below approximately 20 km for the tropics and for northern midlatitudes where there is sufficient data and where the amplitudes of the seasonal and interannual oscillations in CO2 mixing ratios are large enough to be detected. Tropical age spectra are narrow, with seasonal variation indicating faster ascent during northern winter, consistent with a circulation driven by breaking of extratropical waves. The midlatitude CO2 data are consistent with bimodal age spectra, which could result from a subtropical ”barrier” to horizontal exchange over a substantial altitude region. Seasonally resolved mean ages are available with nearly pole-to-pole coverage below 20 km and in the tropics and at middle and high northern latitudes up to the maximum altitude reached by the balloons (approximately 30 km). At ER-2 altitudes, steep meridional gradients in mean age are observed in the subtropics. Between 20 and 30 km, midlatitude air is approximately 2 years older than tropical air at the same altitude. The oldest air sampled was in the Arctic polar vortex with a mean age of .5 plus or minus 0.5 years. This value is much younger than mean ages inferred from simultaneous and previous observations of SF6 in the Arctic vortex, providing evidence for a mesospheric sink for SF6. The mean age in the midlatitude middle stratosphere (approximately 25-32 km) is nearly constant with respect to altitude at 5 plus or minus 0.5 years. Comparison with earlier balloon observations of CO2 dating back to the 1970s shows that the mean age of air in this region has been relatively invariant over the last 25 years.
Author
*Geochronology; Stratosphere; U-2 Aircraft; In Situ Measurement; Annual Variations; Carbon Dioxide Concentration; Tropical Regions*

**20020020656** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Estimation of Mesoscale Atmospheric Latent Heating Profiles from TRMM Rain Statistics Utilizing a Simple One-Dimensional Model**
Iacovazzi, Robert A., Jr., Science Systems and Applications, Inc., USA; Prabhakara, C., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; AMS 11th Conference on Satelite Meteorology and Oceanography, 15-18 Oct. 2001, Madison, WI, USA; Sponsored by American Meteorological Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

In this study, a model is developed to estimate mesoscale-resolution atmospheric latent heating (ALH) profiles. It utilizes rain statistics deduced from Tropical Rainfall Measuring Mission (TRMM) data, and cloud vertical velocity profiles and regional surface thermodynamic climatologies derived from other available data sources. From several rain events observed over tropical ocean and land, ALH profiles retrieved by this model in convective rain regions reveal strong warming throughout most of the troposphere, while in stratiform rain regions they usually show slight cooling below the freezing level and significant warming above. The mesoscale-average, or total, ALH profiles reveal a dominant stratiform character, because stratiform rain areas are usually much larger than convective rain areas. Sensitivity tests of the model show that total ALH at a given tropospheric level

varies by less than +/- 10 % when convective and stratiform rain rates and mesoscale fractional rain areas are perturbed individually by 1 15 %. This is also found when the non-uniform convective vertical velocity profiles are replaced by one that is uniform. Larger variability of the total ALH profiles arises when climatological ocean- and land-surface temperatures (water vapor mixing ratios) are independently perturbed by +/- 1.0 K (+/- 5 %) and +/- 5.0 K (+/- 15 %), respectively. At a given tropospheric level, such perturbations can cause a +/- 25 % variation of total ALH over ocean, and a factor-of-two sensitivity over land. This sensitivity is reduced substantially if perturbations of surface thermodynamic variables do not change surface relative humidity, or are not extended throughout the entire model evaporation layer. The ALH profiles retrieved in this study agree qualitatively with tropical total diabatic heating profiles deduced in earlier studies. Also, from January and July 1999 ALH-profile climatologies generated separately with TRMM Microwave Imager and Precipitation Radar rain statistics, it is shown that ALH profiles can be retrieved utilizing diverse satellite-derived rain products that offer convective and stratiform discrimination. Therefore, the ALH retrieval model developed in this study can be used to make regional estimates of total diabatic heating profiles in the future Global Precipitation Measurement mission, and to assimilate these profiles into numerical weather forecast and climate models.
Author
*Atmospheric Heating; Mesoscale Phenomena; Precipitation (Meteorology); Climatology; Clouds (Meteorology); Mesometeorology*

**20020020661** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Polar Observations of Topside Field-Aligned O+ Flows and Auroral Forms**
Stevenson, B. A., Alabama Univ., USA; Horwitz, J. L., Alabama Univ., USA; Germany, G., Alabama Univ., USA; Moore, T. E., NASA Goddard Space Flight Center, USA; Giles, B. L., NASA Goddard Space Flight Center, USA; Craven, P. D., NASA Marshall Space Flight Center, USA; Chandler, M. O., NASA Marshall Space Flight Center, USA; Su, Y.-J., Los Alamos National Lab., USA; Parks, G. K., Washington Univ., USA; Journal of Geophysical Research; Sep. 01, 2001; ISSN 0148-0227; Volume 106, No. A9, pp. 18,969-18,979; In English; Original contains color illustrations
Contract(s)/Grant(s): NCC8-65; NSF ATM-96-12573; NGT5-40018; RTOP 370-17-43; RTOP 417-13-18; UOW-832213
Report No.(s): Paper-2000JA003042; Copyright; Avail: Issuing Activity

Measurements of thermal O+ ion densities, field-aligned velocities, and fluxes from the Thermal Ion Dynamics Experiment (TIDE) on Polar obtained near 5000 km altitude over the Southern Hemisphere are compared with auroral images from the Ultraviolet Imager (UVI). Three passes were selected for analysis in this paper based on data availability from the TIDE and UVI instruments. Results indicate upward O+ flows in the cleft region but downward O+ flows in the polar cap region. Also, the O+ ion density follows a decreasing trend from the poleward side of the cusp region into the nightside aurora region. The magnitude of the downward O+ parallel velocities increases from dayside to nightside across the polar cap boundary. The upflows tend to occur over or near auroral forms, while the downflows are seen in relatively dark regions, such as the polar cap. These results are consistent with a cleft ion fountain source for the polar cap O+ ions. In the nightside polar cap, the results indicate a transition from downward to upflowing field-aligned O+ ions near boundaries of bright auroral arcs.
Author
*Auroras; Oxygen Ions; Ionospheric Ion Density; Velocity Distribution*

## 47
## METEOROLOGY AND CLIMATOLOGY

*Includes weather observation forecasting and modification*

**20020016172** National Oceanic and Atmospheric Administration, Silver Spring, MD USA
**The application of Kalman filtering to derive water vapor profiles from combined ground-based sensors: Raman lidar, microwave radiometers, GPS, and radiosondes** ***Progress Report, FY 1997***
Westwater, E. R.; Han, Y.; Oct. 05, 1997; 8p; In English
Report No.(s): DE2001-762791; No Copyright; Avail: Department of Energy Information Bridge

Previously, the proposers have delivered to ARM a documented algorithm, that is now applied operationally, and which derives water vapor profiles from combined remote sensor measurements of water vapor radiometers, cloud-base ceilometers, and radio acoustic sounding systems (RASS). With the expanded deployment of a Raman lidar at the CART Central Facility, high quality, high vertical-resolution, water vapor profiles will be provided during nighttime clear conditions, and during clear daytime conditions, to somewhat lower altitudes. The object of this proposal was to use Kalman Filtering, previously applied to the combination of nighttime Raman lidar and microwave radiometer data, to derive high-quality water vapor profiles, during

non-precipitating conditions, from data routinely available at the CART site. Input data to the algorithm would include: Raman lidar data, highly quality-controlled data of integrated moisture from microwave radiometers and GPS, RASS, and radiosondes. The algorithm will include recently-developed quality control procedures for radiometers. The focus of this years activities has been on the intercomparison of data obtained during an intensive operating period at the SGP CART site in central Oklahoma.
NTIS
*Algorithms; Atmospheric Moisture; Global Positioning System; Kalman Filters; Microwave Radiometers; Radiosondes; Remote Sensors*

**20020016173** National Oceanic and Atmospheric Administration, Silver Spring, MD USA
**The application of Kalman filtering to derive water vapor profiles from combined ground-based sensors: Raman lidar, microwave radiometers, GPS, and radiosondes** ***Progress Report, FY 1998***
Westwater, E. R.; Han, Y.; Oct. 01, 1999; 9p; In English
Report No.(s): DE2001-762790; No Copyright; Avail: Department of Energy Information Bridge
Previously, the proposers have delivered to ARM a documented algorithm, that is now applied operationally, and which derives water vapor profiles from combined remote sensor measurements of water vapor radiometers, cloud-base ceilometers, and radio acoustic sounding systems (RASS). With the expanded deployment of a Raman lidar at the CART Central Facility, high quality, high vertical-resolution, water vapor profiles will be provided during nighttime clear conditions, and during clear daytime conditions, to somewhat lower altitudes. The object of this effort is to use Kalman Filtering, previously applied to the combination of nighttime Raman lidar and microwave radiometer data, to derive high-quality water vapor profiles, during non-precipitating conditions, from data routinely available at the CART site. Input data to the algorithm would include: Raman lidar data, highly quality-controlled data of integrated moisture from microwave radiometers and GPS, RASS, and radiosondes. The focus of this years activities has been on the intercomparison of data obtained during the Water Vapor Intensive Operating Period '97 at the SGP CART site in central Oklahoma.
NTIS
*Algorithms; Atmospheric Moisture; Global Positioning System; Kalman Filters; Optical Radar; Radiosondes; Remote Sensors; Microwave Radiometers; Raman Spectra*

**20020016174** National Oceanic and Atmospheric Administration, Silver Spring, MD USA
**The application of Kalman filtering to derive water vapor profiles from combined ground-based sensors: Raman lidar, microwave radiometers, GPS, and radiosondes** ***Progress Report, FY 1999***
Westwater, E. R.; Han, Y.; Sep. 10, 1999; 7p; In English
Report No.(s): DE2001-762789; No Copyright; Avail: Department of Energy Information Bridge
Previously, the proposers have delivered to ARM a documented algorithm, that is now applied operationally, and which derives water vapor profiles from combined remote sensor measurements of water vapor radiometers, cloud-base ceilometers, and radio acoustic sounding systems (RASS). With the expanded deployment of a Raman lidar at the CART Central Facility, high quality, high vertical-resolution, water vapor profiles will be provided during nighttime clear conditions, and during clear daytime conditions, to somewhat lower altitudes. The object of this effort is to use Kalman Filtering, previously applied to the combination of nighttime Raman lidar and microwave radiometer data, to derive high-quality water vapor profiles, during non-precipitating conditions, from data routinely available at the CART site. Input data to the algorithm would include: Raman lidar data, highly quality-controlled data of integrated moisture from microwave radiometers and GPS, RASS, and radiosondes. While analyzing data obtained during the Water Vapor Intensive Operating Period '97 at the SGP CART site in central Oklahoma, several questions arose about the calibration of the ARM microwave radiometers (MWR). A large portion of this years effort was a thorough analysis of the many factors that are important for the calibration of this instrument through the tip calibration method and the development of algorithms to correct this procedure. An open literature publication describing this analysis has been accepted.
NTIS
*Global Positioning System; Kalman Filters; Microwave Radiometers; Radiosondes; Remote Sensors; Water Vapor; Optical Radar*

**20020016175** National Oceanic and Atmospheric Administration, Silver Spring, MD USA
**Continued development of an integrated sounding system in support of the DOE/ARM experimental program** ***Progress Report, FY 1999***
Westwater, E. R.; Han, Y.; Leuskiy, V.; Sep. 08, 1999; 10p; In English
Report No.(s): DE2001-762788; No Copyright; Avail: Department of Energy Information Bridge

Both during September 15-30, 1996 and September 15-October 5, 1997, the Environmental Technology Laboratory (ETL) participated in experiments at the Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site that was designed to study many of the ways that ARM is measuring water vapor. Because of some inconsistencies between ETL and ARM Microwave radiometers (MWR) during these experiments, called the Water Vapor Intensive Operating Periods (WVIOPs), we applied to both sets of data a newly developed correction algorithm for tipping curve calibration. We found that this algorithm reduces the differences between the radiometers, there are still some unexplained features of scanning ARM MWR data. Measurements of water vapor at the North Slope of Alaska and Adjacent Arctic Ocean (NSA/AAO) CART site in Barrow, Alaska, area potential problem because of the difficulty of radiosondes to measure low amounts of vapor during cold and extremely dry conditions. The applicability of MWR scaling to radiosondes is questionable because of the low sensitivity of these instrument during dry conditions. It has been suggested by the ARM Instantaneous Radiative Flux Working Group and others that measurements of brightness temperature around 183 GHz could be used to scale radiosondes during the coldest and driest periods. However, the millimeter wavelengths are vulnerable to cloud effects from both liquid and ice. During March 1999, we participated in the joint NASA/NOAA Millimeter wave Arctic Experiment to evaluate microwave and millimeter wave radiometers during extremely cold conditions. ETL tested, both in an experiment at the Boulder Atmospheric Observatory and during the two Water Vapor Intensive Operating Periods in 1996 and 1997, a 5-mm scanning radiometer that measures low-altitude temperature profiles; both profiles of lapse rate and absolute temperature can be measured with the instrument. Results of these tests were published in the open literature. In addition, the ETL scanning radiometer was operated at the NSA/AAO in March 1999.
NTIS
*Algorithms; Microwave Radiometers; Radiosondes; Precipitation (Meteorology); Clouds (Meteorology); Data Acquisition*

**20020016176** National Oceanic and Atmospheric Administration, Washington, DC USA
**Continued development of an integrated sounding system in support of the DOE/ARM experimental program** ***Progress Report, FY 1998***
Westwater, E. R.; Han, Y.; Leuskiy, V.; Sep. 06, 1998; 12p; In English
Report No.(s): DE2001-762787; No Copyright; Avail: Department of Energy Information Bridge
Both during September 15-30, 1996 and September 15-October 5, 1997, the Environmental Technology Laboratory (ETL) participated in an experiment at the Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site that was designed to study many of the ways that ARM is measuring water vapor. These experiments, called the Water Vapor Intensive Operating Periods (WVIOPs), produced some results of significant importance to ARM water vapor measurements. We have spent the major portion of this years activities in analyzing results of these experiments, and improving algorithms for improving the measurement of precipitable water vapor (PWV) from instruments available at ARM. The most important ARM instrument for this measurement continues to be the Microwave Radiometer (MWR). Measurements of water vapor at the North Slope of Alaska and Adjacent Arctic Ocean (NSA/AAO) CART site in Barrow, Alaska, area potential problem because of the difficulty of radiosondes to measure low amounts of vapor during cold and extremely dry conditions. The applicability of MWR scaling to radiosondes is questionable because of the low sensitivity of these instruments during dry conditions. It has been suggested by the ARM Instantaneous Radiative Flux Working Group and others that measurements of brightness temperature around 183 GHz could be used to scale during the coldest and driest periods. However, the millimeter wavelengths are vulnerable to cloud effects from both liquid and ice. We have participated in the planning and will participate in the Millimeter wave Arctic Experiment that will evaluate microwave and millimeter wave radiometers during extremely cold conditions. ETL has tested, both in an experiment at the Boulder Atmospheric Observatory and during the two Water Vapor Intensive Operating Periods in 1996 and 1997, a 5-mm scanning radiometer that measures low-altitude temperature profiles; both profiles of lapse rate and absolute temperature can be measured with the instrument. The technique and algorithms were developed for continental conditions and produced excellent agreement with in situ data. Due ETL recommendations, an instrument of this type was purchased and will be deployed in the NSA. During this year, we have developed algorithms for this instrument in the NSA and to blend the data with other sources of temperature information, such as Radio Acoustic Sounding Systems (RASS). In addition, we conducted an extensive analysis of the data from this instrument, and compared the data with a variety of in situ ground truth.
NTIS
*Microwave Radiometers; Cloud Physics; Atmospheric Sounding; Algorithms; Precipitation (Meteorology); Acoustics*

**20020016177** National Oceanic and Atmospheric Administration, Washington, DC USA
**Continued development of an integrated sounding system in support of the DOE/ARM experimental program** ***Progress Report***
Westwater, E. R.; Gage, K. S.; Han, Y.; Shaw, J. A.; Churnside, J. H.; Sep. 06, 1996; 8p; In English
Report No.(s): DE2001-762785; No Copyright; Avail: Department of Energy Information Bridge

From January 6 to February 28, 1993, the second phase of the Prototype Radiation Observation Experiment (PROBE) was conducted in Kavieng, Papua New Guinea. Data taken during PROBE included frequent radiosondes, 915 MHz Wind profiler/Radio Acoustic Sounding System (RASS) observations of winds and temperatures, and lidar measurements of cloud-base heights. In addition, a dual-channel Microwave Water Substance Radiometer (MWSR) at 23.87 and 31.65 GHz and a Fourier Transform Infrared Radiometer (FTIR) were operated. The FTIR operated between 500 and 2000 cm(sup-1) and measured some of the first high spectral resolution (1 cm(sup-1)) radiation data taken in the tropics. The microwave radiometer provided continuous measurements with 30-second resolution of precipitable water vapor (PWV) and integrated cloud liquid (ICL), the RASS measured virtual temperature profiles every 30 minutes, and the cloud lidar provided episodic measurements of clouds every minute. The RASS, MWSR, and FTIR data taken during PROBE were compared with radiosonde data. Broadband longwave and shortwave irradiance data and lidar data were used to identify the presence of cirrus clouds and clear conditions. Comparisons were made between measured and calculated radiance during clear conditions, using radiosonde data as input to a Line-By-Line Radiative Transfer Model. Comparisons of RASS-measured virtual temperature with radiosonde data revealed a significant cold bias below 500 m.

NTIS

*Microwave Radiometers; Atmospheric Sounding; Prototypes; Irradiance; Radiosondes; Fourier Transformation; Precipitation (Meteorology); Cloud Physics*

**20020016204** Los Alamos National Lab., NM USA

**Island and Ship Trail Clouds: The Rosetta Stone of Clouds, Pollution, and Climate**

Porch, W.; Winiecki, S.; Jun. 01, 2001; 20p; In English

Report No.(s): DE2001-783158; LA-UR-01-3042; No Copyright; Avail: Department of Energy Information Bridge

Cloud/Climate Feedback is a combination of words known to be important but extremely difficult to quantify or even assign a direction. A 4% increase in boundary layer clouds would cool the Earth as much as a doubling of CO2 would warm it. Studies have shown that warmer sea surface temperatures are associated with fewer clouds. We do not know how much of this effect is due to direct solar warming of surface water in the absence of clouds. We also know there are more eastern ocean marine boundary layer clouds in summer than winter. Do warmer sea surface temperatures or more summer-like conditions best represent global warming. Twomey has proposed that increasing aerosol pollution would lead to brighter clouds (indirect aerosol effect). This relationship does have determined sign (i.e., cooling) but is very difficult to quantify. Cloud trails from ships and islands hold the potential of addressing Cloud/Climate Feedback by observing atmospheric response to large perturbations in turbulence and aerosol. However, before cloud trails can be used as a Rosetta Stone connecting pollution and climate, much more needs to be understood about the micro- and macrophysics of cloud trails.

NTIS

*Atmospheric Boundary Layer; Climate; Clouds (Meteorology); Air Pollution*

**20020016205** Los Alamos National Lab., NM USA

**Cylindrically Symmetric Uniaxial PML Maxwell Solver for Transient Atmospheric Electricity Simulations**

Symbalisty, E. M.; Jul. 01, 2001; 15p; In English

Report No.(s): DE2001-783139; LA-UR-01-3630; No Copyright; Avail: Department of Energy Information Bridge

The recent interest in high altitude discharges known as red sprites, blue jets, and elves has stimulated the modeling of transient atmospheric electricity. The modeling of these high altitude discharges require an initiating cloud-to-ground or intracloud lightning event in order to pre-condition the electric field between the cloud tops and the ionosphere. In this short paper we describe a finite difference time domain (FDTD) numerical solution of Maxwell's equations based on the Yee algorithm coupled with a uniaxial perfectly matched layer boundary treatment. The PML theory has advanced considerably since its original formulation in cartesian coordinates for lossless media, and is computationally efficient to implement. Another boundary treatment possibility for our sources that produce radiative and electrostatic fields, which we do not consider here, is a multipole expansion in the time domain for the electromagnetic fields.

NTIS

*Atmospheric Electricity; Atmospheric Models; Cloud-to-Ground Discharges; Elves; Computerized Simulation; Sprites (Atmospheric Physics)*

**20020016972** NASA Goddard Space Flight Center, Greenbelt, MD USA

**A New Ensemble Canonical Correlation Prediction Scheme for Seasonal Precipitation**

Kim, Kyu-Myong, NASA Goddard Space Flight Center, USA; Lau, William K. M., NASA Goddard Space Flight Center, USA; Li, Guilong, Alberta Univ., Canada; Shen, Samuel S. P., Alberta Univ., Canada; [2001]; 1p; In English; 26th Climate Diagnostics

and Prediction Workshop, 22-26 Oct. 2001, La Jolla, CA, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Department of Mathematical Sciences, University of Alberta, Edmonton, Canada This paper describes the fundamental theory of the ensemble canonical correlation (ECC) algorithm for the seasonal climate forecasting. The algorithm is a statistical regression sch eme based on maximal correlation between the predictor and predictand. The prediction error is estimated by a spectral method using the basis of empirical orthogonal functions. The ECC algorithm treats the predictors and predictands as continuous fields and is an improvement from the traditional canonical correlation prediction. The improvements include the use of area-factor, estimation of prediction error, and the optimal ensemble of multiple forecasts. The ECC is applied to the seasonal forecasting over various parts of the world. The example presented here is for the North America precipitation. The predictor is the sea surface temperature (SST) from different ocean basins. The Climate Prediction Center's reconstructed SST (1951-1999) is used as the predictor's historical data. The optimally interpolated global monthly precipitation is used as the predictand?s historical data. Our forecast experiments show that the ECC algorithm renders very high skill and the optimal ensemble is very important to the high value.

Author

*Correlation; Precipitation (Meteorology); Climatology; Algorithms; Weather Forecasting*

**20020017998** Geological Survey, Reston, VA USA

**Participation of Women in the Fields of Meteorology, Operational Hydrology and Related Geophysical Sciences**

2001; 44p; In English

Report No.(s): PB2001-108849; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

;Table of Contents: Introduction; Questionnaire; Contemporary and Historical Perspectives on Women in WMO; Analysis of Questionnaire Response by Region; Global Summary of Findings; Annex A: Copy of Questionnaire; Annex B: Tables including questionnaire response data and Annex C: References.

NTIS

*Females; Meteorology; Geophysics; Conferences*

**20020018143** Naval Research Lab., Monterey, CA USA

**NAVDAS Source Book 2001**

Jul. 2001; 164p; In English; Original contains color images

Report No.(s): AD-A396883; NRL/PU/7539--01441; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This publication is an update for NAVDAS Source Book 2000 (NRL/PU/7320--00-418). New information is included in revised Appendix H and new Appendix J.

DTIC

*Algorithms; Meteorology; Oceanography*

**20020018149** Oregon State Univ., Coll. of Oceanic and Atmospheric Sciences, Corvallis, OR USA

**The Determination of Macro- and Microphysical Characteristics of Aerosol Spatial Inhomogeneities in the Lower Part of the Marine Atmospheric Boundary Layer from the Backscattered Lidar Signal (the Direct and Inverse Problem)** ***Final Report, 1 Nov. 1993-30 Sep. 2001***

Shifrin, Kusiel S.; Zolotov, Ilin G.; Jan. 2001; 7p; In English

Contract(s)/Grant(s): N00014-94-1-0064

Report No.(s): AD-A396869; N0034C; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The present work is concentrated on studying the aerosol spatial and temporal structure in LP MABL with the use of the database of the unique complex Hawaii experiment SEAS (Shoreline Environment Aerosol Study). by performing a simultaneous analysis of SEAS lidar and nephelometer observations, direct measurements of the aerosol particle size distribution (APSD), and environmental data, and by interpreting the results in terms of the aerosol optical properties, we seek a thorough understanding of the radiative transmittance in LP MABL.

DTIC

*Aerosols; Optical Properties; Optical Radar; Backscattering; Atmospheric Boundary Layer; Marine Environments*

**20020018855** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden

**Diurnal Infrared Texture Variation in an Outdoor Scene**

Uppsaell, M.; Nyberg, S.; Dec. 1999; 42p; In English

Report No.(s): PB2001-108080; FOA-R-99-01373-615-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As a result of the cooperation between FOA (Sweden) and TNO (the Netherlands) regarding feature extraction of targets in backgrounds, FOA had the opportunity to receive experimental data from TNO concerning experiments that were carried out in summer 1992. The aim of the experiment was to relate the diurnal infrared pixel-wise variations in a natural background scene to variations of weather parameters. Results in the data have earlier been reported by TNO. In this extended analysis the diurnal variations in some texture measures and their correlations to weather parameters have been examined.
NTIS
*Infrared Imagery; Targets; Terrain Analysis; Reconnaissance*

**20020018878** Naval Postgraduate School, Monterey, CA USA
**Classification of Summertime West Coast Fog and Stratus Events and the Development of Fog and Stratus Forecast Techniques**
Ireton, Greg S.; Sep. 2001; 149p; In English
Report No.(s): AD-A397067; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
The fog and stratus that frequently plagues the West Coast in the summer months is responsible for a variety of impacts on everyday life, the greatest impact on aviation. Many flight delays and cancellations that are experienced around the Pacific Rim are attributed to the development and evolution of the fog and stratus on the U.S. West Coast. This thesis studies the evolution of the fog and stratus events during the summer of 2000 through the use of geostationary, GOES-10, visual satellite imagery to develop a classification scheme. The synoptic-scale weather patterns as well as the mesoscale coastal regime were then associated with a type of stratus evolution. The Navy's mesoscale model, coupled ocean/atmosphere mesoscale prediction system (COAMPS), provided detailed simulation of 11 events to highlight the boundary layer evolution and its relationship to fog and stratus evolution. The fog and stratus classification scheme produced several consistent synoptic and mesoscale signals associated with stratus evolution. These relationships provide some forecasting techniques that should aid forecasters with predicting the evolution of fog and status events.
DTIC
*Fog; Stratus Clouds; Weather Forecasting; Air Water Interactions; Mesometeorology; Mesoscale Phenomena*

**20020019015** Oklahoma Univ., Norman, OK USA
**Determining the Accuracy and Limits of Predictability of Numerical Weather Prediction for Regional Tactical Military Operations** ***Final Report, 14 Nov. 1997-13 Apr. 2001***
Greene, John S.; Morrissey, Mark L.; May 2001; 9p; In English
Contract(s)/Grant(s): F49620-98-1-0121
Report No.(s): AD-A396982; AFRL-SR-BL-TR-01-0615; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
The US Department of Defense aims to develop capabilities for the numerical prediction of small-scale weather as part of its Theater Battle Management project. This is accomplished at research centers run by each branch of the military. Perhaps the most significant unknown at this point is the specific accuracy of the short-term, high-resolution models and the extent to which the forecasts can provide the guidance needed for tactical military operations. This report provides a detailed description of the research carried out under an Department of Defense Experimental Program to Stimulate Competitive Research (DEPSCoR) grant funded by the Air Force Office of Scientific Research. The overall objectives of this research project were to perform basic research into development of statistical methods for model validation, produce research quality data sets that could be used for operational verification, examine issues in uncertainty characterization, and to identify and examine the accuracies and uncertainties in the operational models currently being run by the Air Force Global Weather Center and the Army Research Laboratory using the Oklahoma Mesonet and other data sets. These research efforts have bee carried out through the interdisciplinary Environmental Verification and Analysis Center (EVAC) at the University of Oklahoma which was established to develop and apply geostatistical methods to utilize point measurements of geophysical data to verify model and remote sensing output. Included in this report is a short list of initial objectives, a summary of the key findings and results, and list of the research publications and presentations produced as a result of this grant.
DTIC
*Accuracy; Numerical Analysis; Numerical Weather Forecasting; Predictions*

**20020020445** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Microphysics, Meteorology, Microwave and Modeling of Mediterranean Storms: The M(sup 5) Problem**

Smith, Eric A., NASA Goddard Space Flight Center, USA; Fiorino, Steven, Florida State Univ., USA; Mugnai, Alberto, Institute of Atmospheric Physics, Italy; Panegrossi, Giulia, Wisconsin Univ., USA; Tripoli, Gregory, Wisconsin Univ., USA; [2001]; 1p; In English; 3rd EGS Plinius Conference on Mediterranean Storms, 1-3 Oct. 2001, Baja Sardinia, Italy, USA; Sponsored by European Geophysical Society, Unknown; No Copyright; Avail: Issuing Activity; Abstract Only

Comprehensive understanding of the microphysical nature of Mediterranean storms requires a combination of in situ meteorological data analysis and radar-passive microwave data analysis, effectively integrated with numerical modeling studies at various scales, particularly from synoptic scale down to mesoscale. The microphysical properties of and their controls on severe storms are intrinsically related to meteorological processes under which storms have evolved, processes which eventually select and control the dominant microphysical properties themselves. Insofar as hazardous Mediterranean storms, highlighted by the September 25-28/1992 Genova flood event, the October 5-7/1998 Friuli flood event, and the October 13-15/2000 Piemonte flood event (all taking place in northern Italy), developing a comprehensive microphysical interpretation requires an understanding of the multiple phases of storm evolution and the heterogeneous nature of precipitation fields within the storm domains. This involves convective development, stratiform transition and decay, orographic lifting, and sloped frontal lifting proc esses. This also involves vertical motions and thermodynamical instabilities governing physical processes that determine details of the liquid/ice water contents, size distributions, and fall rates of the various modes of hydrometeors found within the storm environments. This paper presents detailed 4-dimensional analyses of the microphysical elements of the three severe Mediterranean storms identified above, investigated with the aid of SSM/I and TRMM satellite measurements (and other remote sensing measurements). The analyses are guided by nonhydrostatic mesoscale model simulations at high resolution of the intense rain producing portions of the storm environments. The results emphasize how meteorological controls taking place at the large scale, coupled with localized terrain controls, ultimately determine the most salient features of the bulk microphysical properties of the storms. These results have bearing on precipitation remote sensing from space, and the role of modeling in designing precipitation retrieval algorithms. Author

*Mathematical Models; Microwave Imagery; Remote Sensing; Storms (Meteorology); Mesoscale Phenomena; Computerized Simulation; Mediterranean Sea*

**20020020657** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Combining New Satellite Tools and Models to Examine Role of Mesoscale Interactions in Formation and Intensification of Tropical Cyclones**

Simpson, Joanne, NASA Goddard Space Flight Center, USA; Pierce, H., NASA Goddard Space Flight Center, USA; Ritchie, L., Naval Postgraduate School, USA; Liu, T., Jet Propulsion Lab., California Inst. of Tech., USA; Brueske, K., Wisconsin Univ., USA; Velden, C., Wisconsin Univ., USA; Halverson, J., Maryland Univ. Baltimore County, USA; [2001]; 2p; In English; AMS Conference on Satellite Meteorology, 15-18 Oct. 2001, Madison, WI, USA; Sponsored by American Meteorological Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The objective of this research is to start filling the mesoscale gap to improve understanding and probability forecasts of formation and intensity variations of tropical cyclones. Sampling by aircraft equipped to measure mesoscale processes is expensive, thus confined in place and time. Hence we turn to satellite products. This paper reports preliminary results of a tropical cyclone genesis and early intensification study. We explore the role of mesoscale processes using a combination of products from TRMM, QuikSCAT, AMSU, also SSM/I, geosynchronous and model output. Major emphasis is on the role of merging mesoscale vortices. These initially form in midlevel stratiform cloud. When they form in regions of lowered Rossby radius of deformation (strong background vorticity) the mesoscale vortices can last long enough to interact and merge, with the weaker vortex losing vorticity to the stronger, which can then extend down to the surface. In an earlier cyclongenesis case (Oliver 1993) off Australia, intense deep convection occurred when the stronger vortex reached the surface; this vortex became the storm center while the weaker vortex was sheared out as the major rainband. In our study of Atlantic tropical cyclones originating from African waves, we use QuikSCAT to examine surface winds in the African monsoon trough and in the vortices which move westward off the coast, which may or may not undergo genesis (defined by NHC as reaching TD, or tropical depression, with a west wind to the south of the surface low). We use AMSU mainly to examine development of warm cores. TRMM passive microwave TMI is used with SSM/I to look at the rain structure, which often indicates eye formation, and to look at the ice scattering signatures of deep convection. The TRMM precipitation radar, PR, when available, gives precipitation cross sections. So far we have detailed studies of two African-origin cyclones, one which became severe hurricane Floyd 1999, and the other reached TD2 in June 2000 and then died out. The atmosphere off West African is dry and stable. It becomes less so between June and September, as the SST and convection heat up. QuikSCAT shows the African monsoon trough and shear zone extend westward over the ocean to nearly 30 degrees West. The evidence is strong that the two cyclones had in common multiple midlevel mergers, which extended to the

surface keeping the surface vortex strong. These continued until both systems were designated TD's by NHC. In the June 2000 case, the main reason for failure was the lower SST and dry, stable atmosphere. This is shown by the comparison of the equivalent potential temperature maps and profiles with those from pre-Floyd. In the vortex which became Floyd, QuikSCAT shows continuous importation of high theta e (warm, moist) air from the south. From September 2-8, this air flowed around the vortex center, building up a high theta-e pool to the north. Then late on September 9, a 100-km wide jet of high theta-e air penetrated the vortex core, a major convective burst' was observed, and an intensifying, more elevated warm core was seen on AMSU. Rapid pressure fall and wind intensification were underway by 0000 UTC on September 10. Floyd became a Hurricane at 1200 UTC on Sept 10, 1999, with successive convective bursts running the hurricane thermodynamic engine by intensifying the warm core. TD2 was a strong African vortex, sustained by moderate convection (up to about 12.5 km) offshore of Africa. It peaked on June 23, showing an apparent "eye" on passive microwave composites. However, it could not assemble the ingredients for a convective burst. Thus it failed to get the thermodynamic hurricane engine going before it moved too far west of the region of lowered Rossby radius. by June 26, cloud systems were dying out. On June 25, a surface vortex was no longer seen on QuikSCAT, although one continued above the surface on model profiles until June 27. One of our main findings so far is showing the role of the mesoscale vortex interactions in sustaining some African vortices far out in to the mid Atlantic, where under adequate thermal/moisture conditions the hurricane heat engine can sometimes be started. We are working on similar studies of Cindy and Irene 1999. Cindy illustrates a case of wind shear working against an early-stage hurricane heat engine, while Irene formed from a Caribbean wave. An enormous value of combinations of satellite tools is that tropical cyclones can be studied in all parts of the global oceans where they occur. Detailed studies like ours are labor intensive but many statistical studies can be based on physical postulates developed. There are other new tools such as MODIS on TERRA of the Earth Observing System (EOS) which can be used to study the microphysics of tropical cyclones world wide, in particular to investigate the presence of mixed phase and the impact of atmospheric aerosols on the hydrometeor structure and rainfall from tropical cyclones.
Author
*Mesoscale Phenomena; Cyclones; Tropical Storms; Weather Forecasting; Artificial Satellites*

**20020020997** NASA Goddard Space Flight Center, Greenbelt, MD USA
**On Precipitation Modification by Major Urban Areas: A New Perspective from TRMM**
Pierce, Harold, Science Systems and Applications, Inc., USA; Shepherd, J. Marshall, NASA Goddard Space Flight Center, USA; [2001]; 4p; In English; 11th Conference on Satellite Meteorology and Ocean, 15-18 Oct. 2001, Madison, WI, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

By year 2025, 80% of the world's population will live in cities, according to a 1999 United Nation's report. As cities continue to grow, urban sprawl creates unique challenges related to land use planning, transportation, agriculture, housing, pollution, and development. Urban expansion also has measurable impact on environmental process.
Derived from text
*Cities; Land Management; Land Use; Urban Planning*

**20020021284** National Weather Service, Scientific Services Div., Fort Worth, TX USA
**Severe Weather Climatology for the Birmingham, Alabama County Warning Area**
Hart, P. A.; Linhares, M. A.; Murphy, R. A.; Nov. 2001; 26p; In English
Report No.(s): PB2002-100497; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Weather Service (NWS) has no greater responsibility than warning the public of impending severe weather. A thorough understanding of severe weather climatology can better prepare forecasters for anticipating the timing, strength, extent and nature of severe weather. The purpose of this study is to quantitatively describe the severe weather climatology for Birmingham's County Warning Area (CWA). The Birmingham CWA has undergone several changes through the years. From the early 1970s through the mid-90s the warning responsibility for Alabama's 67 counties was split among six NWS offices, with Birmingham's CWA encompassing 25 counties in north and west-central Alabama. As the modernization and associated restructuring of the NWS drew to a close, CWA configurations in Alabama changed significantly. Birmingham's area of responsibility expanded to include 50 counties in north and central Alabama, including most of the CWA's previously served by Huntsville and Montgomery.
NTIS
*Alabama; Climatology; Meteorological Services; Wind (Meteorology); Storms (Meteorology)*

**20020021288** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Measurements of the Vertical Structure of Aerosols and Clouds Over the Ocean Using Micro-Pulse LIDAR Systems**

Welton, Ellsworth J., Maryland Univ. Baltimore County, USA; Spinhirne, James D., NASA Goddard Space Flight Center, USA; Campbell, James R., Science Systems and Applications, Inc., USA; Berkoff, Timothy A., Maryland Univ. Baltimore County, USA; Bates, David, Miami Univ., USA; [2001]; 8p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The determination of the vertical distribution of aerosols and clouds over the ocean is needed for accurate retrievals of ocean color from satellites observations. The presence of absorbing aerosol layers, especially at altitudes above the boundary layer, has been shown to influence the calculation of ocean color. Also, satellite data must be correctly screened for the presence of clouds, particularly cirrus, in order to measure ocean color. One instrument capable of providing this information is a lidar, which uses pulses of laser light to profile the vertical distribution of aerosol and cloud layers in the atmosphere. However, lidar systems prior to the 1990s were large, expensive, and not eye-safe which made them unsuitable for cruise deployments. During the 1990s the first small, autonomous, and eye-safe lidar system became available: the micro-pulse lidar, or MPL. The MPL is a compact and eye-safe lidar system capable of determining the range of aerosols and clouds by firing a short pulse of laser light (523 nm) and measuring the time-of-flight from pulse transmission to reception of a returned signal. The returned signal is a function of time, converted into range using the speed of light, and is proportional to the amount of light backscattered by atmospheric molecules (Rayleigh scattering), aerosols, and clouds. The MPL achieves ANSI eye-safe standards by sending laser pulses at low energy (micro-J) and expanding the beam to 20.32 cm in diameter. A fast pulse-repetition-frequency (2500 Hz) is used to achieve a good signal-to-noise, despite the low output energy. The MPL has a small field-of-view (is less than 100 micro-rad) and signals received with the instrument do not contain multiple scattering effects. The MPL has been used successfully at a number of long-term sites and also in several field experiments around the world.

Derived from text

*Aerosols; Cloud Cover; Optical Radar; Vertical Distribution; Remote Sensing*

## 48
## OCEANOGRAPHY

*Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also 43 Earth Resources and Remote Sensing.*

**20020016067** NASA Goddard Space Flight Center, Greenbelt, MD USA

**SIMBIOS Project *Annual Report, 2000***

Fargion, Giulietta S., General Sciences Corp., USA; McClain, Charles R., NASA Goddard Space Flight Center, USA; January 2001; 174p; In English; Also announced as 20020016068 through 20020016090

Report No.(s): NASA/TM-2001-209976; Rept-2001-01114-0; NAS 1.15:209976; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The purpose of this technical report is to provide current documentation of the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project activities, NASA Research Announcement (NRAI) research status, satellite data processing, data product validation, and field calibration. This documentation is necessary to ensure that critical information is related to the scientific community and NASA management. This critical information includes the technical difficulties and challenges of validating and combining ocean color data from an array of independent satellite systems to form consistent and accurate global bio-optical time series products. This technical report is not meant as a substitute for scientific literature. Instead, it will provide a ready and responsive vehicle for the multitude of technical reports issued by an operational project.

Author

*Water Color; Satellite Observation; Air Water Interactions; Oceanography; Algorithms*

**20020016068** NASA Goddard Space Flight Center, Greenbelt, MD USA

**An Overview of SIMBIOS Project Activities and Accomplishments During FY00, Chapter 1**

Fargion, Giulietta S., General Sciences Corp., USA; McClain, Charles R., NASA Goddard Space Flight Center, USA; SIMBIOS Project; January 2001, pp. 1-5; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

In FY00, the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project brought a number of activities to fruition and laid the groundwork for new initiatives in FY01 of particular importance was ensuring that the SIMBIOS program was renewed and a new science team selected in FY00. With Sea-Viewing Wide

Field-of-view Sensor (SeaWiFS) continuing to perform well, the Terra platform and Moderate Resolution Imaging Spectroradiometer (MODIS) being launched in December 1999, and several other global missions scheduled for launch (e.g., the Aqua platform with a second MODIS (2001), the ENVISAT mission with the Medium Resolution Imaging Spectrometer (2001), and Advanced Earth Observing Satellite-2 with GLI and Polarization and Directionality of the Earth's Reflectances (POLDER)), the first real opportunities to merge global data sets can be pursued. NASA Headquarters did approve a three-year continuation of the science team under an NASA Research Announcement (NRA) and the Project Office. As it is taking some time for the MODIS team to work through the initial on-orbit processing issues, merger activities within the Project Office have been a low priority with most of the emphasis being on other program objectives which will provide a broader foundation and capabilities for working with multiple global data sets in the future. These activities and accomplishments are described.
Author
*Project Management; Spacecraft Launching; Data Processing*

**20020016069** General Sciences Corp., Beltsville, MD USA
**SIMBIOS: Science Team and Contracts, Chapter 2**
Fargion, Giulietta S., General Sciences Corp., USA; SIMBIOS Project; January 2001, pp. 6-7; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Science Team is selected through NASA Research Announcement (NRA). Presently NASA has had two NRA's, in 1996 and 1999. NASA HQ manages the process of team selection, but the Goddard Space Flight Center (GSFC) NASA Procurement Office handles the team contracts, work statements and, if necessary, budget negotiations. The Project funds numerous US investigators and collaborates with several international investigators, space agencies (e.g., NASDA, CNES, KARI, etc.) and international organizations (e.g., IOCCG, JRQ. US investigators under contract provide in situ atmospheric and bio-optical data sets, and develop algorithms and methodologies for data merger schemes. NASA GSFC Procurement requires formal evaluations for all contracts at the end of each contract year. These evaluations are to go into a database and are shared with the PI's institution or upper management. The locations of specific SIMBIOS team investigations (i.e., NRA-96 and NRA-99) are shown in Figures 2.1 and 2.2. The international ocean color community response for the NRA-99 was overwhelming, with a total of 75 PI's attempting to collaborate with the Project group in twelve proposals. The twelve international proposals cover topics ranging from protocols, calibration-validation activities, atmospheric-biological algorithms, and data merging. The SIMBIOS Science Team (NRA-96) meetings were held in August 1997 at Solomons Island (Maryland), in September 1998 at La Jolla (California) and in September 1999 at Annapolis (Maryland). Meanwhile, the SIMBIOS Science Team's (NRA-99) first meeting will be held in January 2001 at GSFC in Greenbelt, Maryland. In general, all Science Team members, US and international, were in attendance or were represented by one of their staff. Also, the IOCCG and MODIS Teams were invited, and most attended or sent representatives. During each year the Project Office has fostered international collaborations by hosting visiting scientists at GSFC. These visits lasted from one week to several months. For international participants, the Project provided partial or as-needed travel support to team meetings or to collaborate with the project on specific topics such as calibration, and product evaluations. Chapters 4 to 23 contain the individual PI's contributions of the first SIMBIOS team (i.e., NRA-96) and describe the funded research topics, field studies activities, and results of concluded research. These chapters are reproduced as submitted with minimal editing by the Project Office.
Author
*Algorithms; Data Bases; Proposals; Imaging Spectrometers*

**20020016070** NASA Goddard Space Flight Center, Greenbelt, MD USA
**SIMBIOS Project Data Processing and Analysis Results, Chapter 3**
Ainsworth, Ewa, General Sciences Corp., USA; Fargion, Giulietta S., General Sciences Corp., USA; Franz, Bryan, General Sciences Corp., USA; Pietras, Christophe, General Sciences Corp., USA; Smith, Paul, General Sciences Corp., USA; Bailey, Sean, FutureTech Corp., USA; Gales, Joel, FutureTech Corp., USA; Meister, Gerhard, FutureTech Corp., USA; Knobelspiesse, Kirk, Science Systems and Applications, Inc., USA; Werdell, Jeremy, Science Systems and Applications, Inc., USA; SIMBIOS Project; January 2001, pp. 8-25; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project is concerned with ocean color satellite sensor data intercomparison and merger for biological and interdisciplinary studies of the global oceans. Imagery from different ocean color sensors can now be processed by a single software package using the same algorithms, adjusted by different sensor spectral characteristics, and the same ancillary meteorological and environmental data. This enables cross-comparison and validation of the data derived from satellite sensors and, consequently, creates continuity in ocean color information on both the temporal and spatial scale. The next step in this process is the integration of in situ ocean and

atmospheric parameters to enable cross-validation and further refinement of the ocean color methodology. The SIMBIOS Project Office accomplishments during 2000 year are summarized under satellite data processing, data product validation, SeaWiFS Bio-Optical Archive and Storage System (SeaBASS) database, supporting services, sun photometers and calibration activities, and calibration round robins. These accomplishments are described.
Author
*Applications Programs (Computers); Data Processing; Satellite Observation; Calibrating*

**20020016071** National Environmental Satellite Service, Camp Springs, MD USA
**OCTS and SeaWiFS Bio-Optical Algorithm and Product Validation and Intercomparison in US Coastal Waters, Chapter 5**
Brown, Christopher W., National Environmental Satellite Service, USA; Subramaniam, Ajit, Maryland Univ., USA; Culver, Mary, National Oceanic and Atmospheric Administration, USA; Brock, John C., Geological Survey, USA; SIMBIOS Project; January 2001, pp. 34-41; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97879; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Monitoring the health of US coastal waters is an important goal of the National Oceanic and Atmospheric Administration (NOAA). Satellite sensors are capable of providing daily synoptic data of large expanses of the US coast. Ocean color sensors, in particular, can be used to monitor the water quality of coastal waters on an operational basis. to appraise the validity of satellite-derived measurements, such as chlorophyll concentration, the bio-optical algorithms used to derive them must be evaluated in coastal environments. Towards this purpose, over 21 cruises in diverse US coastal waters have been conducted. of these 21 cruises, 12 have been performed in conjunction with and under the auspices of the NASA/Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project. The primary goal of these cruises has been to obtain in-situ measurements of downwelling irradiance, upwelling radiance, and chlorophyll concentrations in order to evaluate bio-optical algorithms that estimate chlorophyll concentration. In this Technical Memorandum, we evaluate the ability of five bio-optical algorithms, including the current Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) algorithm, to estimate chlorophyll concentration in surface waters of the South Atlantic Bight (SAB). The SAB consists of a variety of environments including coastal and continental shelf regimes, Gulf Stream waters, and the Sargasso Sea. The biological and optical characteristics of the region is complicated by temporal and spatial variability in phytoplankton composition, primary productivity, and the concentrations of colored dissolved organic matter (CDOM) and suspended sediment. As such, the SAB is an ideal location to test the robustness of algorithms for coastal use.
Author
*Algorithms; Chlorophylls; Coastal Water; Surface Water; Water Quality; Water Sampling*

**20020016072** Maryland Univ., College Park, MD USA
**Validation of Ocean Color Satellite Data Products in Under Sampled Marine Areas, Chapter 6**
Subramaniam, Ajit, Maryland Univ., USA; Hood, Raleigh R., Maryland Univ., USA; Brown, Christopher W., National Environmental Satellite Service, USA; Carpenter, Edward J., State Univ. of New York, USA; Capone, Douglas G., University of Southern California, USA; SIMBIOS Project; January 2001, pp. 42-50; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97131; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The planktonic marine cyanobacterium, Trichodesmium sp., is broadly distributed throughout the oligotrophic marine tropical and sub-tropical oceans. Trichodesmium, which typically occurs in macroscopic bundles or colonies, is noteworthy for its ability to form large surface aggregations and to fix dinitrogen gas. The latter is important because primary production supported by N2 fixation can result in a net export of carbon from the surface waters to deep ocean and may therefore play a significant role in the global carbon cycle. However, information on the distribution and density of Trichodesmium from shipboard measurements through the oligotrophic oceans is very sparse. Such estimates are required to quantitatively estimate total global rates of N2 fixation. As a result current global rate estimates are highly uncertain. Thus in order to understand the broader biogeochemical importance of Trichodesmium and N2 fixation in the oceans, we need better methods to estimate the global temporal and spatial variability of this organism. One approach that holds great promise is satellite remote sensing. Satellite ocean color sensors are ideal instruments for estimating global phytoplankton biomass, especially that due to episodic blooms, because they provide relatively high frequency synoptic information over large areas. Trichodesmium has a combination of specific ultrastructural and biochemical features that lend themselves to identification of this organism by remote sensing. Specifically, these features are high backscatter due to the presence of gas vesicles, and absorption and fluorescence of phycoerythrin. The

resulting optical signature is relatively unique and should be detectable with satellite ocean color sensors such as the Sea-Viewing Wide Field-of-view Sensor (SeaWiFS).
Derived from text
*Biogeochemistry; Nitrogen; Ocean Models; Plankton; Satellite Observation*

**20020016073** Scripps Institution of Oceanography, San Diego, CA USA
**Bio-Optical Measurement and Modeling of the California Current and Polar Oceans, Chapter 13**
Mitchell, B. Greg, Scripps Institution of Oceanography, USA; SIMBIOS Project; January 2001, pp. 91-98; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97130; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

This Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) project contract supports in situ ocean optical observations in the California Current, Southern Ocean, Indian Ocean as well as merger of other in situ data sets we have collected on various global cruises supported by separate grants or contracts. The principal goals of our research are to validate standard or experimental products through detailed bio-optical and biogeochemical measurements, and to combine ocean optical observations with advanced radiative transfer modeling to contribute to satellite vicarious radiometric calibration and advanced algorithm development. In collaboration with major oceanographic ship-based observation programs funded by various agencies (CalCOFI, US JGOFS, NOAA AMLR, INDOEX and Japan/East Sea) our SIMBIOS effort has resulted in data from diverse bio-optical provinces. For these global deployments we generate a high-quality, methodologically consistent, data set encompassing a wide-range of oceanic conditions. Global data collected in recent years have been integrated with our on-going CalCOFI database and have been used to evaluate Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) algorithms and to carry out validation studies. The combined database we have assembled now comprises more than 700 stations and includes observations for the clearest oligotrophic waters, highly eutrophic blooms, red-tides and coastal case two conditions. The data has been used to validate water-leaving radiance estimated with SeaWiFS as well as bio optical algorithms for chlorophyll pigments. The comprehensive data is utilized for development of experimental algorithms (e.g., high-low latitude pigment transition, phytoplankton absorption, and cDOM).
Author
*Algorithms; In Situ Measurement; Radiative Transfer; Visual Observation; Ocean Currents*

**20020016074** Monterey Bay Aquarium Research Inst., Moss Landing, CA USA
**Bio-Optical Measurements at Ocean Boundaries in Support of SIMBIOS, Chapter 7**
Chavez, Francisco P., Monterey Bay Aquarium Research Inst., USA; Strutton, Peter G., Monterey Bay Aquarium Research Inst., USA; Schlining, Brian M., Monterey Bay Aquarium Research Inst., USA; SIMBIOS Project; January 2001, pp. 51-57; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97134; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The equatorial Pacific is a major component of global biogeochemical cycles, due to upwelling that occurs from the coast of South America to beyond 180 deg. This upwelling has significant implications for global CO2 fluxes, as well as primary and secondary production. In addition, this region of the world's oceans represents a large oceanic province over which validation data for Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) are necessary. This project consists of a mooring program and supporting cruise-based measurements aimed at quantifying the spectrum of biological and chemical variability in the equatorial Pacific and obtaining validation data for SeaWiFS. The project has the following general objectives: (1) to understand the relationships between physical forcing, primary production, nutrient supply and the exchange of carbon dioxide between ocean and atmosphere in the equatorial Pacific; (2) to describe the biological and chemical responses to climate and ocean variability; (3) to describe the spatial, seasonal and inter-annual variability in near surface plant pigments, primary production, carbon dioxide and nutrient distributions; and (4) to obtain near real-time bio-optical measurements for validation of SeaWiFS and subsequent ocean color sensors.
Author
*Air Water Interactions; Pacific Ocean; Optical Measurement; Upwelling Water*

**20020016075** California Univ., Santa Barbara, CA USA

**High Frequency, Long Time Series Measurements from the Bermuda Testbed Mooring in Support of SIMBIOS, Chapter 8**

Dickey, Tommy, California Univ., USA; Dobeck, Laura, California Univ., USA; Sigurdson, David, California Univ., USA; Zedler, Sarah, California Univ., USA; Manov, Derek, California Univ., USA; Yu, Xuri, California Univ., USA; SIMBIOS Project; January 2001, pp. 58-64; In English; Also announced as 20020016067

Contract(s)/Grant(s): NAS5-97127; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

It has been recognized that optical moorings are important platforms for the validation of Sea-Viewing Wide Field-of-view Sensor (SeaWiFS). It was recommended that optical moorings be maintained in order to: (1) provide long-term time series comparisons between in situ and SeaWIFS measurements of normalized water-leaving radiance; (2) develop and test algorithms for pigment biomass and phytoplankton primary productivity; and (3) provide long-term, virtually continuous in situ observations which can be used to determine and optimize the accuracy of derived satellite products. These applications require the use of in situ radiometers for long periods of time to evaluate and correct for inherent satellite undersampling (aliasing and biasing) and degradation of satellite color sensors (e.g., drifts as experienced by the Coastal Zone Color Scanner). The Bermuda Testbed Mooring (BTM) program was initiated in 1994 at a site located about 80km southeast of Bermuda in waters of about 4530 m depth. In August 1997, with NASA's support, we started to provide the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) program with large volumes of high frequency, long-term time-series bio-optical data from the BTM for SeaWiFS satellite ocean color groundtruthing and algorithm development. This NASA supported portion of the BTM activity spanned three years and covered five BTM deployments. During these three years, the quality of radiometric data has improved dramatically. Excellent agreement between BTM moored data and both SeaWiFS and nearby ship profile radiometric data demonstrate that technical advances in the moored optical observations have reduced the major difficulties that moored platforms face: biofouling and less frequent calibration.

Author

*Mooring; Time Series Analysis; Research; In Situ Measurement*

**20020016076** Old Dominion Univ., VA USA

**Remote Sensing of Ocean Color in the Arctic: Algorithm Development and Comparative Validation, Chapter 9**

Cota, Glenn F., Old Dominion Univ., USA; SIMBIOS Project; January 2001, pp. 65-70; In English; Also announced as 20020016067

Contract(s)/Grant(s): NAS5-97132; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The overall goal of this effort is to acquire a large bio-optical database, encompassing most environmental variability in the Arctic, to develop algorithms for phytoplankton biomass and production and other optically active constituents. A large suite of bio-optical and biogeochemical observations have been collected in a variety of high latitude ecosystems at different seasons. The Ocean Research Consortium of the Arctic (ORCA) is a collaborative effort between G.F. Cota of Old Dominion University (ODU), W.G. Harrison and T. Platt of the Bedford Institute of Oceanography (BIO), S. Sathyendranath of Dalhousie University and S. Saitoh of Hokkaido University. ORCA has now conducted 12 cruises and collected over 500 in-water optical profiles plus a variety of ancillary data. Observational suites typically include apparent optical properties (AOPs), inherent optical property (IOPs), and a variety of ancillary observations including sun photometry, biogeochemical profiles, and productivity measurements. All quality-assured data have been submitted to NASA's SeaWIFS Bio-Optical Archive and Storage System (SeaBASS) data archive. Our algorithm development efforts address most of the potential bio-optical data products for the Sea-Viewing Wide Field-of-view Sensor (SeaWiFS), Moderate Resolution Imaging Spectroradiometer (MODIS), and GLI, and provides validation for a specific areas of concern, i.e., high latitudes and coastal waters.

Author

*Algorithms; Biogeochemistry; Biomass; Data Bases; Visual Observation; Variability*

**20020016077** Scripps Institution of Oceanography, San Diego, CA USA

**Satellite Ocean Color Validation Using Merchant Ships, Chapter 10**

Frouin, Robert, Scripps Institution of Oceanography, USA; Cutchin, David L., Scripps Institution of Oceanography, USA; Deschamps, Pierre-Yves, Universite des Sciences et Techniques de Lille Flandres Artois, France; SIMBIOS Project; January 2001, pp. 71-79; In English; Also announced as 20020016067

Contract(s)/Grant(s): NAS5-97135; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

A collaborative measurement program for evaluating satellite-derived ocean color has been developed based on ships of opportunity (merchant, oceanographic) and specific instrumentation, the SIMBAD radiometer. The purpose of the measurement program is to complement, in a cost-effective way, dedicated evaluation experiments at sea, which are expensive, cannot be carried

out over the full range of expected oceanic and atmospheric conditions, and generally provide a few match-ups. Ships participate in the program on a volunteer basis or at a very small cost, and measurement procedures do not interfere with other ship activities. The SIMBAD radiometer is a portable, easy-to-operate instrument that measures the basic ocean color variables, namely aerosol optical thickness and water-leaving radiance, in typical spectral bands of ocean-color sensors, i.e., 443, 490, 560, 670, and 870 nm. Measuring these variables at the time of satellite overpass is usually sufficient to verify satellite-derived ocean color and to evaluate atmospheric correction algorithms. Any ordinary crew can learn quickly how to make measurements. Importantly, the ship is not required to stop, making it possible to collect data along regular routes traveled by merchant ships in the world's oceans. Derived from text

*Water Color; In Situ Measurement; Radiometers*

**20020016078** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

**High Altitude Measurements of Radiance at High Spectral and Spatial Resolution for SIMBIOS Sensor Calibration, Validation, and Intercomparisons, Chapter 11**

Green, Robert O., Jet Propulsion Lab., California Inst. of Tech., USA; Pavri, Betina, Jet Propulsion Lab., California Inst. of Tech., USA; Chrien, Thomas G., Jet Propulsion Lab., California Inst. of Tech., USA; SIMBIOS Project; January 2001, pp. 80-83; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The successful combination of data from different ocean color sensors depends on the correct interpretation of signal from each of these sensors. Ideally, the sensor measured signals are calibrated to geophysical units of spectral radiance, and sensor artifacts are removed and corrected. The calibration process resamples the signal into a common radiometric data space so that subsequent ocean color algorithms that are applied to the data are based on physical processes and are inherently sensor independent. The objective of this project is to calibrate and validate the on-orbit radiometric characteristics of Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) with underflights of NASA's calibrated Airborne Visible/Infrared Imaging Spectrometer (AVIRIS). This objective is feasible because AVIRIS measures the same spectral range as SeaWIFS at higher spectral resolution. In addition to satellite sensor underflights, the AVIRIS project has supported comparison and analysis of the radiometric calibration standards used for AVIRIS and SeaWIFS. to date, both the OCTS and SeaWIFS satellite sensors have been underflown by AVIRIS with matching spectral, spatial, geometric, radiometric, and temporal domains. The calibration and validation objective of this project is pursued for the following reasons: (1) Calibration is essential for the quantitative use of SeaWIFS and other SIMBIOS (Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies) sensor data; (2) Calibration in the laboratory of spaceborne sensors is challenging; (3) Satellite sensors are subjected aging on the ground and to trauma during launch; (4) The Earth orbit environment is significantly different than the laboratory calibration environment; (5) Through years of effort AVIRIS has been demonstrated to be well calibrated; and (6) AVIRIS can match the spectral and spatial observation characteristics near the top of the atmosphere at the time of SeaWIFS measurements.

Author

*Calibrating; Imaging Spectrometers; Infrared Spectrometers; Satellite Observation; Sea-Viewing Wide Field-Of-View Sensor*

**20020016079** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Merging Ocean Color Data from Multiple Missions, Chapter 12**

Gregg, Watson W., NASA Goddard Space Flight Center, USA; SIMBIOS Project; January 2001, pp. 84-90; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Oceanic phytoplankton may play an important role in the cycling of carbon on the Earth, through the uptake of carbon dioxide in the process of photosynthesis. Although they are ubiquitous in the global oceans, their abundances and dynamics are difficult to estimate, primarily due to the vast spatial extent of the oceans and the short time scales over which their abundances can change. Consequently, the effects of oceanic phytoplankton on biogeochemical cycling, climate change, and fisheries are not well known. In response to the potential importance of phytoplankton in the global carbon cycle and the lack of comprehensive data, the National Aeronautics and Space Administration (NASA) and the international community have established high priority satellite missions designed to acquire and produce high quality ocean color data. Seven of the missions are routine global observational missions: the Ocean Color and Temperature Sensor (OCTS), the Polarization and Directionality of the Earth's Reflectances sensor (POLDER), Sea-viewing Wide Field-of-view Sensor (SeaWiFS), Moderate Resolution Imaging Spectrometer-AM (MODIS-AM), Medium Resolution Imaging Spectrometer (MERIS), Global Imager (GLI), and MODIS-PM. In addition, there are several other missions capable of providing ocean color data on smaller scales. Most of these missions contain the spectral band complement considered necessary to derive oceanic pigment concentrations (i.e., phytoplankton abundance) and other related parameters. Many contain additional bands that can provide important ancillary information about the optical and biological state of the oceans. Any individual ocean color mission is limited in ocean coverage due to sun glint and clouds. For

example, one of the first proposed missions, the SeaWiFS, can provide about 45% coverage of the global ocean in four days and only about 15% in one day.
Author
*Carbon Cycle; Phytoplankton; Water Color; Data Processing*

**20020016080** San Diego State Univ., Center for Hydro-Optics and Remote Sensing, San Diego, CA USA
**SIMBIOS Normalized Water-Leaving Radiance Calibration and Validation: Sensor Response, Atmospheric Corrections, Stray Light and Sun Glint, Chapter 14**
Mueller, James L., San Diego State Univ., USA; SIMBIOS Project; January 2001, pp. 99-100; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97126; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

This Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) contract supports acquisition of match up radiometric and bio-optical data for validation of Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) and other ocean color satellites, and evaluation of uncertainty budgets and protocols for in situ measurements of normalized water leaving radiances.
Author
*Calibrating; In Situ Measurement; Radiance; Water Color*

**20020016081** University of South Florida, Dept. of Marine Science, Saint Petersburg, FL USA
**Validation of Carbon Flux and Related Products for SIMBIOS: The CARIACO Continental Margin Time Series and the Orinoco River Plume, Chapter 15**
Muller-Karger, Frank, University of South Florida, USA; Hu, Chuanmin, University of South Florida, USA; Akl, John P., University of South Florida, USA; Varela, Ramon, Fundacion La Salle de Ciencias Naturales, Venezuela; SIMBIOS Project; January 2001, pp. 101-108; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97128; NAG5-6448; NSF OCE-92-16626; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Between 1997 and 2000, this Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) investigation collected bio-optical measurements in the Southeastern Caribbean Sea and the tropical western Atlantic to help understand the color of coastal and continental shelf waters. Specifically, bio-optical data were collected to complement an oceanographic time series maintained within the Cariaco Basin, a site affected by seasonal coastal upwelling. Bio-optical data were also collected within the plume of the Orinoco River during seasonal extremes in discharge. This program focused on providing data to the Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) and SIMBIOS Projects for validating SeaWiFS products. The data are unique in that they provide a substantial number of observations on repeated seasonal cycles for the SeaWIFS Bio-Optical Archive and Storage System (SeaBASS) bio-optical database. An important aspect of this SIMBIOS investigation was a focus on proper interpretation of ocean color remote sensing data from coastal and continental shelf environments. With this goal in mind, ocean color satellite data from a variety and locations and from different satellite sensors were examined to understand spatial and temporal variability in pigment concentrations, and also to conduct an in-depth study of current atmospheric correction and bio-optical algorithms.
Author
*Carbon; Coastal Water; Continental Shelves; Spatial Distribution; Temporal Distribution; Water Color*

**20020016082** California Univ., ICESS, Santa Barbara, CA USA
**The Bermuda Bio-Optics Program (BBOP), Chapter 16**
Siegel, David A., California Univ., USA; SIMBIOS Project; January 2001, pp. 109-116; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97125; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The Bermuda Bio-Optics Project (BBOP) is a collaborative effort between the Institute for Computational Earth System Science (ICESS) at the University of California at Santa Barbara (UCSB) and the Bermuda Biological Station for Research (BBSR). This research program is designed to characterize light availability and utilization in the Sargasso Sea, and to provide an optical link by which biogeochemical observations may be used to evaluate bio-optical models for pigment concentration, primary production, and sinking particle fluxes from satellite-based ocean color sensors. The BBOP time-series was initiated in 1992, and is carried out in conjunction with the US JGOFS Bermuda Atlantic Time-series Study (BATS) at the Bermuda Biological Station for Research. The BATS program itself has been observing biogeochemical processes (primary productivity, particle flux at and elemental cycles) in the mesotrophic waters of the Sargasso Sea since 1988. Closely affiliated with BBOP and

BATS is a separate NASA-funded study of the spatial variability of biogeochemical processes in the Sargasso Sea using high-resolution Advanced Very High Resolution Radiometer (AVHRR) and Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) data collected at Bermuda. The collaboration between BATS and BBOP measurements has resulted in a unique data set that addresses not only the SIMBIOS goals but also the broader issues of important factors controlling the carbon cycle.
Author
*Biogeochemistry; Water Color; Calibrating; Spacecraft Instruments*

**20020016083** California Univ., ICESS, Santa Barbara, CA USA
**Spectral Data Assimilation for Merging Satellite Ocean Color Imagery, Chapter 17**
Siegel, David A., California Univ., USA; Maritorena, Stephane, California Univ., USA; SIMBIOS Project; January 2001, pp. 117-124; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-98083; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) project was initiated 'to develop a methodology and operational capability to combine data products from various ocean color missions in a manner that ensures the best possible global coverage and best exploits the complementary missions of the sensors'. While the merging of data from multiple sources has already been implemented for sea surface temperature (SST), altimetry or clouds, this is a new topic in ocean color science. Merging ocean color data has obvious advantage in terms of spatial and temporal coverage of the global ocean but data merging should also result in new, more diverse and improved data products with lower uncertainties. The merging of ocean color satellite data is generally considered at the level of the global gridded products, i.e., NASA Level-3 and, more specifically, for the merging of chlorophyll a concentration data, [Ch1]. This approach limits computational issues and deals with a unique, simple quantity, [Ch1]. However, ocean color data merging can also be conducted at the level of water-leaving radiances, LwN(lamda), using either empirical or semi-analytical algorithms. Although more challenging, this latter approach is potentially extremely powerful as it can achieve good consistency in the final data products and can take advantage of both the specificities and differences of each source of data. The demonstration of the feasibility of such approach is the main objective of our SIMBIOS work. Here, we use a semi-analytical algorithm to merge Rrs (or, equivalently LwN) data from different sources to estimate [Ch1]. The model also allows for the retrieval of other quantities such as the combined absorption of colored detrital particulate and dissolved organic matter at 443 nm, a(sub cdm)(443) and the particulate backscattering, b(sub bp)(443).
Derived from text
*Emission Spectra; Water Color; Data Correlation; Satellite Observation*

**20020016084** Oregon State Univ., Coll. of Oceanic and Atmospheric Sciences, Corvallis, OR USA
**SIMBIOS Data Product and Algorithm Validation with Emphasis on the Biogeochemical and Inherent Optical Properties, Chapter 18**
Zaneveld, J. Ronald V., Oregon State Univ., USA; Pegau, W. Scott, Oregon State Univ., USA; Barnard, Andrew H., Oregon State Univ., USA; SIMBIOS Project; January 2001, pp. 125-130; In English; Also announced as 20020016067
Contract(s)/Grant(s): NAS5-97129; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The purpose of our component of the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) program is to address and quantify the relative accuracy of the various ocean color remote sensing products by means of product and algorithm validation. In order to accomplish these goals, we have been collaborating in an international research program in the Gulf of California designed to examine the spatial and temporal bio-optical variability in this region. In addition, we participated in various cruises of opportunity to supplement our validation data set. Our long-term objectives are to: (1) collect optical and biochemical data in oceanic and coastal regions of interest; (2) provide collected data to the Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) Bio-Optical Archive and Storage System (SeaBASS) database, the SIMBIOS project office, and other interested users; (3) maintain and update instrumentation and data archiving and dissemination systems; and (4) determine spatial and temporal error fields for the biological and geophysical data products from the various ocean color missions.
Author
*Biogeochemistry; Optical Properties; Remote Sensing; Water Color; Algorithms; Accuracy*

**20020016085** Brookhaven National Lab., Upton, NY USA

**Aerosol Optical Properties over the Oceans: Summary and Interpretation of Shadow-Band Radiometer Data from Six Cruises, Chapter 19**

Miller, Mark A., Brookhaven National Lab., USA; Reynolds, R. M., Brookhaven National Lab., USA; Bartholomew, Mary Jane, Brookhaven National Lab., USA; SIMBIOS Project; January 2001, pp. 132-139; In English; Also announced as 20020016067

Contract(s)/Grant(s): NAS5-97888; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The aerosol scattering component of the total radiance measured at the detectors of ocean color satellites is determined with atmospheric correction algorithms. These algorithms are based on aerosol optical thickness measurements made in two channels that lie in the near-infrared portion of the electromagnetic spectrum. The aerosol properties in the near-infrared region are used because there is no significant contribution to the satellite-measured radiance from the underlying ocean surface in that spectral region. In the visible wavelength bands, the spectrum of radiation scattered from the turbid atmosphere is convolved with the spectrum of radiation scattered from the surface layers of the ocean. The radiance contribution made by aerosols in the visible bands is determined from the near-infrared measurements through the use of aerosol models and radiation transfer codes. Selection of appropriate aerosol models from the near-infrared measurements is a fundamental challenge. There are several challenges with respect to the development, improvement, and evaluation of satellite ocean-color atmospheric correction algorithms. A common thread among these challenges is the lack of over-ocean aerosol data. Until recently, one of the most important limitations has been the lack of techniques and instruments to make aerosol measurements at sea. There has been steady progress in this area over the past five years, and there are several new and promising devices and techniques for data collection. The development of new instruments and the collection of more aerosol data from over the world's oceans have brought the realization that aerosol measurements that can be directly compared with aerosol measurements from ocean color satellite measurements are difficult to obtain. There are two problems that limit these types of comparisons: the cloudiness of the atmosphere over the world's oceans and the limitations of the techniques and instruments used to collect aerosol data from ships. to address the latter, we have developed a new type of shipboard sun photometer.

Derived from text

*Aerosols; Algorithms; Atmospheric Models; Data Acquisition; Oceans; Optical Properties; Photometers; Satellite Observation*

**20020016089** Academy of Sciences (USSR), Ocean Optics Lab., Moscow, USSR

**Validation of the Water-Leaving Radiance Data Product, Chapter 23**

Kopelevich, Oleg V., Academy of Sciences (USSR), USSR; Burenkov, Vladimir I., Academy of Sciences (USSR), USSR; Ershova, Svetlana V., Academy of Sciences (USSR), USSR; Sheberstov, Sergey V., Academy of Sciences (USSR), USSR; Evdoshenko, Marina A., Academy of Sciences (USSR), USSR; Karabashev, Genrik S., Academy of Sciences (USSR), USSR; Pavlov, Constantine A., Academy of Sciences (USSR), USSR; SIMBIOS Project; January 2001, pp. 157-162; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The project accomplishments made by the Scripps Institution of Oceanography RAS group during the period of 1997-2000 are described. The goal of this research was to assess an accuracy of data products derived from satellite ocean color data including an accuracy of the atmospheric correction algorithms for variety of meteorological and oceanological conditions and of the bio-optical algorithms for different water cases. A combined approach was used which included a direct comparison of the values of water-leaving radiance and chlorophyll concentration derived from satellite and in situ measured data as well as numerical simulation and theoretical analysis.

Author

*Algorithms; Atmospheric Correction; Radiance; Satellite Observation; Computerized Simulation*

**20020016090** Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME USA

**Validation of Surface Bio-Optical Properties in the Gulf of Maine as a Means for Improving Satellite Primary Production Estimates, Chapter 4**

Balch, William M., Bigelow Lab. for Ocean Sciences, USA; SIMBIOS Project; January 2001, pp. 26-33; In English; Also announced as 20020016067

Contract(s)/Grant(s): NAS5-97268; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

One of the greatest challenges in providing sea-truth data for various ocean color sensors is climatology. This is particularly true in the Gulf of Maine since it is cloudy and foggy more than it is clear; the climatology shows on average, about one in four to five days has clear skies with clear days slightly more frequent in the late summer and early fall. Our strategy has been to use a ship of opportunity where one has choice of the sampling days. This provides much better flexibility to sample during clear periods with good satellite coverage. Our Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) contract has been to use the M/S Scotia Prince ferry as a ship of opportunity, running between Portland, Maine

and Yarmouth, NS. Measurements include continuous, surface, along-track fluorescence, two independent measures of backscattering, total light scattering, absorption, beam attenuation, above-water remote sensing reflectance, calcite-dependent light scattering, temperature, and salinity. Expendable bathythermography (XBT) drops allow acquisition of vertical temperature information, useful for defining isopycnal slope, which affects primary production. These data are comparable to a previous program from early 1982, where a ship of opportunity program (SOOP) was run on the truck ferry, M/V Marine Evangeline, which ran along the same transect. These surface data were combined with satellite-derived sea surface temperature fields to examine the Maine coastal current. Unfortunately, this program stopped in 1982. The ongoing SIMBIOS results will dovetail nicely with the previous work (which also had Coastal Zone Color Scanner (CZCS) coverage) for looking at any long-term changes in the Gulf of Maine hydrography, bio-optics, and biogeochemistry.
Derived from text
*Biogeochemistry; Climatology; Satellite Observation; Sea Truth; Sea Surface Temperature; Water Sampling*

**20020016705** Bonneville Power Administration, Portland, OR USA
**Summary of the Skookumchuck Creek bull trout enumeration project 2000**
Baxter, J. S.; Baxter, J.; Feb. 01, 2001; 38p; In English
Report No.(s): DE2001-783953; DOE/BP-28027-2; No Copyright; Avail: Department of Energy Information Bridge

An enumeration fence and traps were installed on Skookumchuck Creek from September 7 th to October 16 th to enable the capture of post-spawning bull trout emigrating out of the watershed. During the study period, a total of 252 bull trout were sampled through the enumeration fence. Length, weight, and sex were determined for all but one of the 252 bull trout captured. In total, one fish of undetermined sex, 63 males and 188 females were processed through the fence. A total of 67 bull trout were observed on a snorkel survey prior to the fence being removed on October 16 th . Coupled with the fence count, the total bull trout count during this project was 319 fish. Several other species of fish were captured at the enumeration fence including westslope cutthroat trout, Rocky Mountain whitefish, kokanee, sucker, and Eastern brook trout. Redds were observed during ground surveys in three different locations (river km 27.5-28.5, km 29-30, and km 24-25). The largest concentration of redds were noted in the upper two sections which have served as the index sections over the past four years. A total of 197 bull trout redds were enumerated on the ground on October 4 th . The majority of redds (n=189) were observed in the 3.0 km index section (river km 27.5-30.5) that has been surveyed over the past four years. The additional 8 redds were observed in a 1.5 km section (river km 24.0-25.5). Summary plots of water temperature for Bradford Creek, Sandown Creek, Skookumchuck Creek at km 39.5, and Skookumchuck Creek at the fence site suggested that water temperatures were within the range preferred by bull trout for spawning, egg incubation, and rearing.
NTIS
*Fishes; Enumeration; Watersheds*

**20020018005** Center for Mathematics and Computer Science, Amsterdam Netherlands
**New Generation Shelf Flux Models. Modelling, Analysis and Simulation**
Stelling, G.; Roose, D.; Sommeijer, B. P.; van der Houwen, P. J.; Kok, J.; Aug. 1998; 22p; In English
Report No.(s): PB2001-108641; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

The ecological condition of the Continental Shelf is of great concern for many countries. The understanding of the integrated effects that result in the present and future situation requires answers on many research topics, such as flow modelling, including turbulence and large eddy simulation, transport processes, chemistry, ecology, etc. This paper focuses on 'high performance computing issues' for flux modeling. Flux modelling of contaminants, nutrients and ecosystem parameters in general in the Continental Shelf is essential to improve the understanding of this important ecosystem. From a computational point of view, flux modelling is a 'grand challenge;' its computational demands are so huge that the present state-of-the-art does not yield numerical models of desired accuracy. Several assumptions and simplifications are needed to arrive at 'manageable' numerical models whose run times are acceptably low.
NTIS
*Continental Shelves; Large Eddy Simulation; Turbulence*

## 51
## LIFE SCIENCES (GENERAL)

*Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see categories 52 through 55.*

**20020016088** Maryland Univ., Horn Point Lab., Cambridge, MD USA
**Sources of Variability in Chlorophyll Analysis by Fluorometry and by High Performance Liquid Chromatography, Chapter 22**
VanHeukelem, Laurie, Maryland Univ., USA; Thomas, Crystal S., Maryland Univ., USA; Glibert, Patricia M., Maryland Univ., USA; SIMBIOS Project; January 2001, pp. 149-156; In English; Also announced as 20020016067; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The need for accurate determination of chlorophyll a (chl a) is of interest for numerous reasons. From the need for ground-truth data for remote sensing to pigment detection for laboratory experimentation, it is essential to know the accuracy of the analyses and the factors potentially contributing to variability and error. Numerous methods and instrument techniques are currently employed in the analyses of chl a. These methods range from spectrophotometric quantification, to fluorometric analysis and determination by high performance liquid chromatography. Even within the application of HPLC techniques, methods vary. Here we provide the results of a comparison among methods and provide some guidance for improving the accuracy of these analyses. These results are based on a round-robin conducted among numerous investigators, including several in the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) and HyCODE Programs. Our purpose here is not to present the full results of the laboratory intercalibration; those results will be presented elsewhere. Rather, here we highlight some of the major factors that may contribute to the variability observed. Specifically, we aim to assess the comparability of chl a analyses performed by fluorometry and HPLC, and we identify several factors in the analyses which may contribute disproportionately to this variability.
Author
*Chlorophylls; Variability*

**20020016149** Consejo Superior de Investigaciones Cientificas, Madrid Spain
**VI International Congress on Pseudomonas: Molecular Biology and Biotechnology, Scientific Program and Abstracts**
Sep. 08, 1997; 162p; In English
Report No.(s): AD-A396769; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report contains abstracts of the 6th International Congress on Pseudomonas: Molecular Biology and Biotechnology held in Madrid, Spain , 4-8 September 1997.
DTIC
*Molecular Biology; Biotechnology*

**20020016251** Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA
**Neighborhood Emergency Help Center Pamphlet: Mass Casualty Care Strategy for Biological Terrorism Incidents *Final Report, Mar. 2000-May 2001***
Church, James K., Jr.; Wall, William T.; Dragunas, Ginturas A.; Logsdon, Heather L.; Blackman, Edward A.; Sep. 2001; 27p; In English; Prepared in collaboration with Booz-Allen & Hamilton, Abingdon, MD, and Research Planning, Inc., Gunpowder, MD
Report No.(s): AD-A396549; ECBC-TR-203; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This pamphlet is intended to serve as a summary of the Neighborhood Emergency Help Center (NEHC) Concept of Operations. The NEHC is a high volume triage center that is part of a larger biological warfare response concept referred to as the Modular Emergency Medical System (MEMS). The NEHC will divert casualties and 'worried well' away from emergency departments, will render basic medical evaluation and triage, will provide limited treatment including stabilization care, and will distribute prophylactic medication and self-help information. This pamphlet describes the scope of care, the required staffing levels, the NEHC functional areas, the patient flow, and the other requirements needed to set up and operate an NEHC. The NEHC is designed, staffed, and resourced to process 1000 patients per day.
DTIC
*Casualties; Emergencies; Terrorism; Medical Services*

**20020016272** General Accounting Office, Washington, DC USA

**Testimony Before the Committee on Energy and Commerce, House of Representatives. Bioterrorism: The Centers for Disease Control and Prevention's Role in Public Health Protection**

Heinrich, Janet; Nov. 15, 2001; 20p; In English

Report No.(s): AD-A396583; GAO-02-235; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This testimony discusses work on the Centers for Disease Control and Prevention's (CDC) activities to prepare the nation to respond to the public health and medical consequences of a bioterrorist attack. The country is now dealing with anthrax exposures resulting from the agent being sent through the mail and the consequences of dealing with even limited exposures have proven to be quite significant. Prior to the recent anthrax incidents, a domestic bioterrorist attack had been considered to be a low-probability event, in part because of the various difficulties involved in successfully delivering biological agents to achieve large-scale casualties. On September 28, 2001, we released a report that describes (1) the research and preparedness activities being undertaken by federal departments and agencies to manage the consequences of a bioterrorist attack, (2) the coordination of these activities, and (3) the findings of reports on the preparedness of state and local jurisdictions to respond to a bioterrorist attack. This statement will summarize our findings in the September report regarding CDC's research and preparedness activities on bioterrorism and augments the previous work on combating terrorism. This report will focus on CDC's research and preparedness activities on bioterrorism, and remaining gaps that could hamper the response to a bioterrorist event.

DTIC

*Public Health; Terrorism; Biological Weapons*

**20020016275** Georgetown Univ. Hospital, Medical Center, Washington, DC USA

**Electrical Impedance Imaging of the Breast: Correlation with MRI, US, Sestamibi, and Histology with Measures of Cell Proliferation and Vascular Density** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***

Freedman, Matthew T.; Sep. 2001; 46p; In English

Contract(s)/Grant(s): DAMD17-00-1-0260

Report No.(s): AD-A396559; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This project was designed to test a new method for the evaluation of lesions suspected as possible cancers after their initial detection. Electrical Impedance Imaging (EII) is a novel method for the evaluation of breast lesions that relies on measurements of the electrical impedance and capacitance of breast tissues. It showed, in previous trials, good ability to distinguish benign and malignant lesions. The system received FDA approval 4/16/99. The work on this project was delayed because we have not yet received approval from the US Army to start the clinical trial. New information also indicates the need for protocol modification and we have submitted the new protocol for approval. Because the system is FDA approved, we have been using it both clinically and in other clinical trials and have discovered that the system is not ready for the type of use originally proposed. The main problem is that the system has a very large number of false positive findings, that is findings that are positive by EII criteria, but are not cancer. In some breasts four or more such false positives can be found.

DTIC

*Cancer; Electrical Impedance; Imaging Techniques; Lesions; Mammary Glands*

**20020016495** NASA Ames Research Center, Moffett Field, CA USA

**Effects of Chronic 2.0% and 0.7% CO2 Exposures on the Well-Being, Growth and Renal Function of Rats**

Lang, C. K., NASA Ames Research Center, USA; Alexander, R. A., Bionetics Corp., USA; Steele, M. K., Martin Marietta Corp., USA; Wade, C. E., NASA Ames Research Center, USA; [1995]; 1p; In English; 16th Annual Gravitational Physiology Meeting, 19-24 Mar. 1995, Reno, NV, USA

Contract(s)/Grant(s): RTOP 199-16-12-01; No Copyright; Avail: Issuing Activity; Abstract Only

On the Space Shuttle and MIR, mean CO2 levels have been 0.3% which is ten times that of normal air. There have also been extended periods with levels of 0.7% CO2 with peak concentrations at 2.0%. The Space Station program had proposed that CO2 concentration levels be maintained, on average, at 0.7%, and not to exceed 1.0%. to ensure that these levels of CO2 would not compromise the integrity of the science performed on the Space Station, the effects of chronic exposure of rats to 2.0% and 0.7% CO2 were investigated. Ten male rats per group were placed in individual metabolic cages for monitoring of food and water consumption, as well as fecal and urine production. Cages were placed in a large (4W x 10L x 4H ft.) plexiglass chamber with a controlled atmospheric environment. Following 7 days of cage adaptation, animals were exposed to experimental (2.0% or 0.7% CO2) or control (ambient air) conditions for 30 days. Daily body weight, food and water intake, and fecal and urine excretions were measured for the last three days of adaptation and the first ten days of exposure and then every three to four days for the remaining three weeks. Urine was measured for pH and total CO2. During 2.0% and 0.7% CO2 exposures, animal growth, fecal production and food and water consumption were within normal ranges. Urine excretion was significantly (p less than 0.05) higher

in both experimental groups compared to controls. Urine pH of animals exposed to 2.0% CO2 was decreased by 0.32 over the first 6 days of exposure, followed by a 0.63 increase by day 30. In animals exposed to 0.7% CO2, urine pH did not decrease early in the exposure period, but did increase by 0.37 by day 30. Urine CO2 excretion did not change the first 6 days of exposure, but significantly increased in both 2.0% and 0.7% CO2 by day 30 (897 and 402 mmol/day, respectively). These results of chronic exposure to 2.0% and 0.7% CO2 are consistent with renal compensation in response to an altered acid-base homeostasis. These findings may impact science conducted on the Space Shuttle or the Space Station if CO2 concentrations reach 0.7%.
Author
*Body Weight; Carbon Dioxide Concentration; Exposure; Metabolism; Rats*

**20020016500** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Solar UV Radiation and the Origin of Life on Earth**
Heap, S. R., NASA Goddard Space Flight Center, USA; Gaidos, E., Hawaii Univ., USA; Hubeny, I., NASA Goddard Space Flight Center, USA; Lanz, T. M., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; AAS 199th Conference, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

We have embarked on a program aimed at understanding the atmosphere of the early Earth, because of its importance as a greenhouse, radiation shield, and energy source for life. Here, we give a progress report on the first phase of this program: to establish the UV radiation from the early Sun. We are presently obtaining ultraviolet spectra (STIS, FUSE, EUVE) of carefully selected nearby, young solar-type stars, which act as surrogates for the early Sun. We are currently making detailed non-LTE analyses of the spectra and constructing models of their photospheres + chromospheres. once validated, these models will allow us to extrapolate our theoretical spectra to unobserved spectral regions, and to proceed to the next step: to develop photochemical models of the pre-biotic and Archean atmosphere of the Earth.
Author
*Solar Radiation; Ultraviolet Radiation; Biological Evolution; Greenhouse Effect; Life Sciences; Photochemical Reactions*

**20020016862** North Carolina Agricultural and Technical State Univ., Div. of Research, Greensboro, NC USA
**Designing a Unique Single Point Cross Over Method**
Wilson, Richard Phillip, North Carolina Agricultural and Technical State Univ., USA; [2002]; 24p; In English
Contract(s)/Grant(s): NGT-52178
Report No.(s): NCA/TSU-4-42089; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The idea behind genetic algorithms is to extract optimization strategies nature uses successfully - known as Darwinian Evolution - and transform them for application in mathematical optimization theory to find the global optimum in a defined phase space. One could imagine a population of individual 'explorers' sent into the optimization phase-space. Each explorer is defined by its genes, what means, its position inside the phase-space is coded in his genes. Every explorer has the duty to find a value of the quality of his position in the phase space. (Consider the phase-space being a number of variables in some technological process, the value of quality of any position in the phase space - in other words: any set of the variables - can be expressed by the yield of the desired chemical product.) Then the struggle of 'life' begins. The three fundamental principles are selection, mating/crossover, and mutation. Only explorers (= genes) sitting on the best places will reproduce and create a new population. This is performed in the second step (mating/crossover). The 'hope' behind this part of the algorithm is, that 'good' sections of two parents will be recombined to yet better fitting children. In fact, many of the created children will not be successful (as in biological evolution), but a few children will indeed fulfill this hope. These good sections are named in some publications as building blocks. Now there appears a problem. Repeating these steps, no new area would be explored. The two former steps would only exploit the already known regions in the phase space, which could lead to premature convergence of the algorithm with the consequence of missing the global optimum by exploiting some local optimum. The third step, mutation, ensures the necessary accidental effects. One can imagine the new population being mixed up a little bit to bring some new information into this set of genes. Whereas in biology a gene is described as a macro-molecule with four different bases to code the genetic information, a gene in genetic algorithms is usually defined as a bitstring (a sequence of b 1's and 0's).
Author
*Biological Evolution; Genes; Genetic Algorithms; Mutations*

**20020017398** Columbia Univ., New York, NY USA

**Role of DIP1, a Novel Id-Like Protein in Breast Cancer** ***Final Report, 1 Jul. 1999-30 Jun. 2001***

Weinstein, I. B.; Jul. 2001; 23p; In English

Contract(s)/Grant(s): DAMD17-99-1-9156

Report No.(s): AD-A396929; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We found that DIP 1, a novel 45 Kda nuclear protein recently identified in our laboratory, is frequently expressed in primary human breast cancers and breast cancer cell lines. However the level of expression 0 DIP 1 in breast cancer cells appears to be lower than that in normal mammary epithelial cells. Overexpression of DIP 1 in MCF-7 human breast cancer cells inhibited colony formation and cell proliferation but did not inhibit specific phases of the cell cycle. In mechanistic studies we found that DIP 1 inhibits the transcriptional activities of the cyclin Dl, c-fos, SRE, and NF Kappa B promoters.

DTIC

*Proteins; Cancer; Mammary Glands*

**20020017401** Michigan Univ., Ann Arbor, MI USA

**Breast Cancer Vaccines Based on Dendritic Cells and the Chemokines** ***Final Report, 1 Jul. 1996-30 Jun. 2001***

Mule, James J.; Jul. 2001; 35p; In English

Contract(s)/Grant(s): DAMD17-96-1-6103

Report No.(s): AD-A396908; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The major objective of this project was to establish a new modality for the treatment of breast cancer that employs the combination of chemokines with breast tumor-pulsed dendritic cells to both recruit and/or concentrate from the periphery low frequency immune reactive T cells as well as to potently stimulate these effector cells once localized at the vaccination site. This final report documents our successes in a number of areas, both experimentally and clinically. We have completed the overall project, which has resulted in twenty-nine publications, the awarding of a new spin-off NCI (National Cancer Institute) / NIH (National Institutes of Health) RO1 clinical research grant and a T32 training grant in translational tumor immunology and immunotherapy, as well as the initiation of a phase II clinical trial in advanced breast cancer patients. During the course of our studies related to the Technical Objectives, we made the important discovery that SLC can significantly inhibit the growth of breast tumor in mice. We successfully constructed a recombinant adenovirus vector containing the SLC gene, which can transduce both animal and human dendritic cells at high efficiency for use in our cancer vaccine strategy. A second vaccine clinical trial in breast cancer patients to incorporate SLC-producing dendritic cells is planned.

DTIC

*Lymphocytes; Vaccines; Mammary Glands; Cancer; Therapy*

**20020017402** Scripps Research Inst., La Jolla, CA USA

**Vitronectin and Integrin (alpha)v(beta)3 in Ovarian Carcinoma** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***

Huang, Shuang; Jul. 2001; 5p; In English

Contract(s)/Grant(s): DAMD17-00-1-0566

Report No.(s): AD-A396906; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

One hallmark of ovarian cancer is the presence of large amount of floating cells in ascites. However, it is unknown how ovarian cancer cells can survive in absence of adhesion. Our early studies showed that ovarian cancer cells express vitronectin and alphavbeta3 integrin on cell surface, and the interaction between them is essential for ovarian cancer cell survival in suspension. In present study, we found that engaging alphavbeta3 with vitronectin induced NF-kB activation; Super electrophoresis mobility shift assay with antibodies against individual member of NF-kB family showed that p50 and p65 were in the DNA-protein complex. to determine the importance of NF-kB activity in ovarian cancer cell survival, we blocked NF-KB activity by either expressing dominant negative form of IkB or using NF-kB inhibitors D609 or SN50. In a two day growth period, the inhibition of NP- KB activity resulted in over 80% of cell death in ovarian cancer cells cultured in suspension, but did not significantly affect the survival of ovarian cancer cells cultured in adhesion. These results strongly suggest that vitronectin/ alphavbeta3 interaction-mediated NF-KB activity is essential for ovarian cancer cell survival in absence of adhesion, and may explain why ovarian cancer cells can survive in suspension.

DTIC

*Deoxyribonucleic Acid; Ovaries; Cancer*

**20020017404** Scripps Research Inst., La Jolla, CA USA

**Regulation and Function of Pak Signaling in Ovarian Cancer** ***Annual Report, 1 Aug. 2000-31 Jul. 2001***

Knaus, Ulla G.; Aug. 2001; 7p; In English

Contract(s)/Grant(s): DAMD17-00-1-0563

Report No.(s): AD-A396904; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The identification of genes, which play a critical role in malignant transformation of the ovarian epithelium, will allow developing molecular tools for detection or intervention of altered activities in ovarian cancer, a cancer, which is often discovered in a late stage and with poor prognosis. Protein kinases such as p2l- activated kinases (Paks) are valuable targets for pharmacological intervention. Our project will elucidate alternative molecular mechanisms present in ovarian cancer cell lines, which lead to hyperactive Pak. The effect of Pak activity on ovarian cell functions and detection of active Pak in tissues are additional goals. Radiolabeled ovarian cancer cell lines were screened for the presence of activating Pak tyrosine phosphorylation. Our data suggest that this mechanism is not prevalent in these cells. Next approaches will include adenoviral infection of dominant negative signaling molecules and the use of pharmacological inhibitors specific for certain growth factor receptors. Anti-phospho Pak antibody production was not successful, but similar antibodies produced by collaborators will be used for further Pak studies. The influence of Pak on cancer cell proliferation will be delineated with inducible cell lines. Increased knowledge about Pak signaling in cancer is an important step towards Pak inhibitor development.

DTIC

*Genes; Receptors (Physiology); Ovaries; Cancer*

**20020017405** New York Univ., School of Medicine, New York, NY USA

**Genetic Susceptibility to Prostate Cancer in the Netherlands** ***Annual Report, 1 Aug. 2000-31 Jul. 2001***

Ostrer, Harry; Aug. 2001; 6p; In English

Contract(s)/Grant(s): DAMD17-00-1-0523

Report No.(s): AD-A396902; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Studies of the genetics of populations that were historically endogamous for reasons of geography, religion, or language have contributed substantially to our understanding about hereditary predisposition to cancer. One such population is found in the Netherlands where multiple, prevalent, population-specific founder mutations have been identified. Genetic susceptibility to prostate cancer is being investigated in the Netherlands Cohorts Study (NLCS) on Diet and Cancer, which has identified over 800 cases of prostate cancer among 58,279 male participants. From this study, we have identified 300 cases and 300 controls from among men of comparable age to identify markers near prostate cancer susceptibility genes that are present at higher frequency in the group of men with prostate cancer. We have optimized the methods for analysis of these markers. During the next year, we will apply these methods to analyzing the samples that have been collected.

DTIC

*Genetics; Prostate Gland; Cancer; Populations*

**20020017406** Cincinnati Univ., OH USA

**Role of CD44 in Malignant Peripheral Nerve Sheath Tumor Growth and Metastasis** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***

Sherman, Larry S.; Sep. 2001; 9p; In English

Contract(s)/Grant(s): DAMD17-00-1-0551

Report No.(s): AD-A396901; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Malignant peripheral nerve sheath tumors (MPNST) are aggressive, difficult to treat tumors that occur in type I neurofibromatosis patients with an increased incidence compared to the general population. These tumors metastasize to a number of sites, including the lungs, and have a poor 5 year survival rate. We previously found that MPNSTs overexpress the CD44 tranmembrane glycoprotein and that reducing CD44 expression inhibits MPNST cell invasion. We also found that aberrant CD44 expression is linked to overexpression of the epidermal growth factor receptor (EGFR) in these cells through a Ras-independent mechanism. Here, we provide evidence that EGFR upregulates CD44 expression in the ST88l4 cell line through a mechanism that depends on SRc kinase. Furthermore, we show that MPNST cell invasion depends on an autocrine loop involving MCF, an MCF activating enzyme (MGFA), and c-Met, all of which are expressed by MPNST cells. We are currently conducting studies that link CD44 to increased c-Met activity and signaling, and determining the mechanism by which CD44 influences the MCF-c-Met autocrine loop. These studies provide new insights into the mechanisms of MPMST invasion as well as potential targets for the treatment of these tumors.

DTIC

*Nerves; Cells (Biology); Epidermis; Growth*

**20020017407** Johns Hopkins Univ., School of Medicine, Baltimore, MD USA
**RAR Beta Methylation and Loss of RAR Beta Expression in Breast Cancer** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***
Sacchi, Nicoletta; Sep. 2001; 19p; In English
Contract(s)/Grant(s): DAMD17-99-1-9241
Report No.(s): AD-A396900; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The search of chemopreventive strategies for breast cancer is imperative. It is vital to identify critical early events that can increase the risk that a normal epithelial mammary cell may be transformed into a breast cancer cell. Exposure to estrogen, already recognized as a predisposing event for breast cancer, formed the rationale for preventive trials based on an antiestrogen compound (tamoxifen). This proposal explores the mechanism of another likely predisposing event for breast cancer, the loss of expression of the retinoic acid receptor beta (RAR beta), a nuclear receptor that responds to derivatives of vitamin A. Loss of expression of RAR beta was reported in breast cancer, as well as in other epithelial cancers. Our IDEA project aims to understand the mechanisms involved in RAR beta loss, in order to devise strategies not only to reverse this loss, but also to prevent it. In the first year of investigation, we found that a mechanism of transcriptional silencing of genes called hypermethylation is an important factor of irreversible RAR beta loss in breast cancer cells. In the second year we tested in depth the epigenetic mechanisms (deacetylation of P2) leading to downregulation and loss of RAR beta expression and development of RA resistance. This paves the road to a) treatment of RA-resistant breast cancer and 2) chemoprevention of breast cancer by maintaining an appropriate activity of the RAR beta P2 promoter to deter the occurrence of epigenetic events responsible for RAR beta silencing and RA-resistance.
DTIC
*Mammary Glands; Methylation; Cancer*

**20020017408** Tel-Aviv Univ., Ramat-Aviv, Tel-Aviv Israel
**Analysis of the Secreted Novel Breast-Cancer-Associated MUC1/Zs Cytokine** ***Annual Report, 1 Jun. 2000-31 May 2001***
Wreschner, Daniel H.; Jun. 2001; 6p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-00-1-0451
Report No.(s): AD-A396834; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

As described in our research proposal the MUC1 gene is expressed in secretory epithelial tissues and at exceptionally high levels in human breast cancer cells. It is a well-known and widely accepted marker for breast cancer that can generate several functionally distinct MUC1 protein isoforms some containing a 20 amino acid tandem-repeat-array and additional forms lacking this domain. Findings emanating originally from our laboratory and subsequently confirmed by others, implicate the participation of the MUC1 proteins in signaling pathways. Analysis of MUC1 1 RT-PCR cDNA products revealed a supplementary and unique splice variant, MUC1/Zs, which is devoid of the tandem repeat array and utilizes a perfect out-of- frame splice acceptor site downstream to the tandem repeats. This splice event generates a secreted MUC1/Zs protein that harbors an N-terminal signal peptide and which contains a unique C-terminal stretch of 43 amino acids- this region shows marked homology with restricted regions of known cytokines and chemokines. We proposed to investigate the hypothesis that the MUCl/Zs protein is a novel, biologically important, cytokine by (a) analyzing MUC1/Zs protein expression in tumor tissues and correlating this expression with that of other MUC1 1 isoforms, (b) characterizing the signaling function of MUC1 1 /Zs and proteins (receptor molecules?) with which the MUC1/Zs protein interacts, and (c) studying, both in-vivo and in in-vitro, the effect on tumor cell growth mediated by the MUC1/Zs protein.
DTIC
*Epithelium; Genes; Acceptor Materials; Amino Acids; Cancer; Mammary Glands*

**20020017409** Chicago Univ., Chicago, IL USA
**Comparative Structural Analysis of ERa and ERb Bound to Selective Estrogen Agonists and Antagonists** ***Annual Report, 14 Jun. 2000-13 Jun 2001***
Greene, Geoffrey L.; Jul. 2001; 57p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-99-1-9120
Report No.(s): AD-A396833; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The goal of this investigation is to determine the three-dimensional structures of the two known human estrogen receptors (ERalpha and ERbeta) complexed with receptor-selective estrogens and antiestrogens (SERMs) The crystallographic structures of ERalpha and ERbeta ligand binding domains complexed with cis-R,R-diethyl-tetrahydrochrysene-2,8-diol (R,R-THC) have been solved and refined, suggesting mechanisms by which this compound can act as an ERalpha agonist and as an ERbeta antagonist. Agonists and antagonists bind at the same site within the core of the ER LBD to induce distinct conformations in the transactivation domain (AF-2), especially in the positioning of helix 12. Previously determined structures of ERa with

4-hydroxytamoxifen (OHT) and diethylstilbestrol (DES) revealed and defined a multipurpose docking site on ERalpha and ERbeta that can accommodate either helix 12, in the presence of OHT, or one of several co-regulators in the presence of DES. R,R-THC stabilizes a conformation of the ERalpha LBD that favors coactivator association and a conformation of the ERbeta LBD that prevents coactivator association. A comparison of the two structures, combined with functional data, reveals that THC does not act on ERbeta through the same mechanisms used by other known ER antagonists. Instead, THC antagonizes ERbeta through a novel mechanism we term ”passive antagonism”. Paradoxically, the R,R-THC-ERbeta structure is very similar to the structure induced by genistein, which acts as a partial estrogen through both ER subtypes. Ongoing mutagenesis studies should help define the molecular and structural differences that are responsible for these unanticipated results. The passive antagonism mechanism suggests a novel approach to the design of ligands that selectively antagonize the two ER subtypes. Such ligands may have novel therapeutic properties that can be exploited to prevent or treat breast cancer.
DTIC
*Estrogens; Mutagenesis; Mammary Glands; Cancer*

**20020017410** Cleveland Clinic Foundation, Cleveland, OH USA
**EOSinophils as Mediators of DNA Oxidative Damage in Breast Cancer** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Hazen, Stanley; Jul. 2001; 33p; In English
Contract(s)/Grant(s): DAMD17-99-1-9133
Report No.(s): AD-A396832; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The overall goal of this proposal is to test the hypothesis that eosinophils promote DNA oxidative damage in breast carcinoma. DNA oxidative damage is linked to mutation, transformation and cancer development and eosinophil peroxidase (EPO), a hemoprotein secreted from eosinophils, is present in the majority of breast cancer biopsies. Our initial aim was to determine whether EBO promotes oxidative damage of cellular DNA through formation of mutagenic hydroxyl radical (OH) -generated bases. Last year we published a study (Biochemistry, (2O00) 39:5474) that demonstrated activated leukocytes can oxidatively damage DNA, RNA and the nucleotide pool through halide-dependent formation of OH. OH-dependent damage of DNA was quantified by monitoring the content of 8- hydroxyguanine (8OHG), an established OH-specific DNA oxidation product that is mutagenic and implicated in breast cancer development and progression to metastatic disease. to test the hypothesis that EPO promotes DNA oxidative damage in human breast carcinoma, we have identified a family of novel brominated DNA oxidation products. These may serve as molecular fingerprints” for DNA damage by the EPO pathway of eosinophils. The results of our initial studies identifying brominated bases by mass spectrometry were recently published (Biochemistry, (2001) 40:2041-2051) We are presently performing studies aimed at quantifying these EPO-specific brominated bases in a well-characterized repository of breast carcinoma and microscopically normal breast tissue specimens.
DTIC
*Deoxyribonucleic Acid; Oxidation; EOSinophils; Mediation; Nucleotides; Biochemistry*

**20020017411** Mayo Foundation, Rochester, MN USA
**Chemotherapeutic and Immunotherapeutic Effects of 15-deoxy-delta12, 14-prostaglandin J2 on Prostate Cancer** ***Final Report, Phase I. 1 Sep. 1998-28 Feb. 2001***
Young, Charles; Mar. 2001; 28p; In English
Contract(s)/Grant(s): DAMD17-98-1-8523
Report No.(s): AD-A396831; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
It has been suggested that compositions of essential fatty acids (EFAs) in diets consumed by humans can largely affect the incident rates of many cancers including prostate cancer. In fact, omega-3 polyunsaturated essential fatty acids (PUFAs) such as docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) and one of their terminal metabolites, 15-deoxy-delta12,l4-prostaglandin J2 (15d-PGJ2) may be involved in cell growth and differentiation. The peroxisome proliferator activated receptors (PPARs) as transcription factors are the mediators for some of these hormone-like lipids. Our aims were to determine the growth responses of human prostate cells to l5d-PGJ2 and related lipids and the role of PPARgamma. Additional study was to investigate the effects of DHA and EPA on androgen receptor mediated action in prostate cancer. We completed these aims. It was found that the expression and functions of PPARgamma were activated by 15d-PGJ2 and DHA. PPARgamma was also detected by western analysis in human prostate cancerous tissues. Moreover, in contrast to other studies with non-prostate cells, we showed that both androgen responsive and -refractory prostate cells are all induced by 15d-PGJ2 and PUFAs to undergo, instead of differentiation into adipocyte-like cells, S-phase cell cycle arrest and non-apoptotic programmed cell death. Interestingly. we discovered that DHA, 15d-PGJ2 and/or EPA- can interfere with androgen receptor’s function in human prostate cancer cells. Further studies seem to indicate that these PUFAs can activate an inhibitory cross-talking component,

AP-l protein, that interacted with and inhibited androgen receptor's function. Our studies provide a strong basis for the use of these PUFAs as intervening means to prevent or treat prostate cancer.
DTIC
*Chemotherapy; Prostate Gland; Apoptosis; Cancer*

**20020017412** Baylor Coll. of Medicine, Houston, TX USA
**HET is a Novel Tumor Suppressor Gene in Human Breast Cancer** ***Annual Report, 1 Apr.-30 Sep. 2000***
Oesterreich, Steffi; Oct. 2000; 53p; In English
Contract(s)/Grant(s): DAMD17-98-1-8340
Report No.(s): AD-A396830; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We have evidence that the nuclear matrix protein RET might represent an important tumor suppressor gene in human breast cancer: (1) Overexpression of HET inhibited growth. (2) it was negatively associated with S-phase fraction in breast tumors, and 16% of breast tumors did not express HET. (3) Western Blot analysis in breast tumors led to the detection of smaller products, presumably representing truncated HET proteins. (4) RET maps to a locus on chromosome 19P13 where we detected an unusually high rate of loss of heterozygozity. In the first specific aim we will directly answer whether RET is the tumor suppressor gene by performing additional LOH analysis and mutational analysis of RET in breast cancer cell lines as well as in tumors. in the second specific aim we will perform functional analysis of discovered RET mutations in breast cancer cell lines. if RET is the tumor suppressor gene at l9p13, this will have a direct impact on the mechanistic understanding of tumor suppressor genes in breast cancer, as this region has an extremely high LOH rate in human breast cancer. if our hypothesis is true, then mutational analysis of RET could become a very informative tool for breast cancer prognosis and therapy..
DTIC
*Genes; Mammary Glands; Suppressors; Cancer; Prognosis*

**20020017413** Boston Univ., School of Medicine, Boston, MA USA
**Recombinant Polyclonal Antibody Libraries for Breast Cancer Therapy** ***Annual Report, 1 Sep. 1999-31 Aug. 2000***
Sharon, Jacqueline; Sep. 2000; 30p; In English
Contract(s)/Grant(s): DAMD17-98-1-8285
Report No.(s): AD-A396829; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This project proposes the development of a recombinant polyclonal antibody library specific for the human breast carcinoma cell line BT-20. The proposed library would target multiple epitopes on the human cell line and also provide the genes necessary for the unlimited perpetuation of the defined antibody mixture. Ultimately, such antibody libraries could be used for treatment and diagnosis of breast cancer in humans. In the present study, an Fab phage display library specific for the BT-2O cells has been generated. to obtain a polyclonal antibody library of whole IgG antibodies that would mediate effector functions, a vector system for mammalian expression has been constructed. The new system uses restriction enzyme-based transfer of variable region gene pairs from a phage display to a mammalian expression vector. This system will be used to complete the construction of an anti-breast cancer polyclonal antibody library.
DTIC
*Antigens; Mammary Glands; Cancer; Bacteriophages; Immune Systems; Libraries*

**20020018032** Johns Hopkins Univ., School of Medicine, Baltimore, MD USA
**Molecular Mechanisms of Bacterial Superantigen Function** ***Annual Report, 14 Aug. 2000-13 Aug 2001***
Sadegh-Nasseri, Scheherazade; Sep. 2001; 6p; In English
Contract(s)/Grant(s): DAMD17-00-1-0671
Report No.(s): AD-A396810; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The objectives of this project included: (1) clone and express a human T cell receptor (TCR) gene in bacteria; (2) clone and express a human T cell receptor gene in insect cells; and (3) determine the binding kinetics of the soluble T cell receptor to complexes of HLA-DRl/HA and Ses in real time using an optical biosensor. We cloned individual c DNA of a and b chains of a human TCR, clone 1, in bacteria. Acidic and basic sequences of Leucine zipper were added to either gene to facilitate proper protein folding. Each gene was expressed in bacterial expression system. Our accomplishments (by objective) included: (1) Beta chain of TCR was produced in inclusion bodies of the expressing bacteria to over 90% purity; (2) Alpha chain of TCR was produced in inclusion bodies but mixed with many other proteins; and (3) At present, we can properly fold TCR from bacteria, as confirmed by ELISA, but with a low yield. We attempted to optimize refolding of TCR by mixing a larger proportion of chain

protein with the beta chain, trying several protein folding methods, and using other strains of bacteria expressing the gene to increase compatibility with the a chain. Adding 5% glycerol helped refolding.
DTIC
*Bacteria; Proteins; Cloning (Biology); Antigens; Cells (Biology)*

**20020018041** Georgetown Univ., Medical Center, Washington, DC USA
**A Comprehensive Postdoctoral Training Program in Breast Cancer** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Dickson, Robert B.; Jul. 2001; 7p; In English
Contract(s)/Grant(s): DAMD17-00-1-0271
Report No.(s): AD-A396719; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The goal of this training program is to significantly extend our existing, highly successful Doctoral Training Program in Tumor Biology and several Cancer Center mechanisms that provide traditional postdoctoral training and junior faculty career development. The program integrates faculty from the Lombardi Cancer Center programs in Cancer Prevention and Control and Cancer Genetics and makes use of the existing organizational structure of the interdisciplinary Doctoral Training Program in Tumor Biology and incorporates a multi-disciplinary faculty who are devoted to research and education in breast cancer. We have two postdoctoral fellows who have successfully completed their first year in the program and are now entering their second year of research. We have recruited one postdoctoral fellow to the program thus far who will arrive in September, 2001. Our recruitment for our second incoming class will be completed in the Fall, 2001.
DTIC
*Mammary Glands; Cancer; Education*

**20020018042** Georgetown Univ., Medical Center, Washington, DC USA
**Combined M.D./Ph.D. and Ph.D. Training Program in Breast Cancer Prevention** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Dickson, Robert B.; Jul. 2001; 9p; In English
Contract(s)/Grant(s): DAMD17-99-1-9198
Report No.(s): AD-A396716; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The goal of this training program is to dramatically extend our existing, highly successful Interdisciplinary Doctoral Training Program in Tumor Biology with a new track which integrates genetics, molecular epidemiology, and prevention of breast cancer. This new track offers both MD/PhD and PhD training opportunities, and integrates new faculty from the Lombardi Cancer Center Programs in Cancer Prevention and Control, and Cancer Genetics. The program is enriched by new courses, as well as practical research experience. This new programmatic initiative makes use of the existing organizational structure of the Interdisciplinary Doctoral Training Program in Tumor Biology and incorporates a multi-disciplinary faculty who are devoted to research and education in breast cancer. We have successfully completed our second year of the program and recruited our third incoming class of 2 MDs who are interested in pursuing PhDs. In addition, 1 MD/PhD student and 1 PhD student are continuing into their second year of enrollment in the program. Finally, new courses in Genetics in Health and Society and Biostatistics have been added to the program.
DTIC
*Mammary Glands; Cancer; Education*

**20020018044** Colorado Univ., Health Sciences Center, Aurora, CO USA
**Ph.D. Post-Doctoral Training Program in Breast Cancer Research** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Edwards, Dean P.; Jul. 2001; 77p; In English
Contract(s)/Grant(s): DAMD17-00-1-0474
Report No.(s): AD-A396710; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The training program is designed to graduate well-qualified and highly motivated scientists who will make a career in the breast cancer research field and who will have a strong potential for contributing new research approaches to the breast cancer problem. The students accepted into the program have already entered into different Ph.D. degree granting programs that each have their own guidelines, curriculums, and requirements. The curriculum of the Breast Cancer Training Program extends beyond that of the normal Ph.D. requirements to include didactic classroom teaching, journal clubs, seminars, workshops, and mini-symposiums on relevant topics in breast cancer. Additionally, the program provides extensive one-on-one laboratory training in breast cancer research that is committed to the discovery of new fundamentals about the biology of breast cancer and

its eventual treatment, The faculty who serve as research mentors have established records of successful training of Ph.D. and M.D./Ph.D. students.
DTIC
*Cancer; Education; Mammary Glands; Research; Medical Science*

**20020018047** Thomas Jefferson Univ., Philadelphia, PA USA
**Multi-Pulse Ultrasound Contrast Imaging for Improved Breast Cancer Diagnosis** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***
Forsberg, Flemming; Sep. 2001; 10p; In English
Contract(s)/Grant(s): DAMD17-00-1-0662
Report No.(s): AD-A396967; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Preliminary reports indicate that ultrasound contrast significantly improves the sensitivity and specificity of breast ultrasound imaging. We propose using a patented multi-pulse contrast imaging technique. This technique applies two acoustic fields one for bubble excitation and the other for imaging. The excitation field will momentarily increase bubble sizes resulting in an increase in the number of bubbles with a size close to the resonance size corresponding to the (second) imaging field. If the imaging field is applied simultaneously with (or slightly after) the excitation field, acoustic scattering from bubbles around resonance size becomes markedly stronger than without the excitation field. This project will optimize the performance of ultrasound systems for use in breast imaging with contrast agents, in conventional as well as harmonic imaging modes, by developing multi-pulse contrast specific imaging. to date, an in vitro dual-transducer pulse-echo system has been built to evaluate excitation enhanced imaging and initial experiments have been conducted with the contrast agents Sonazoid and Sonavist. Up to 12 and 16 dB improvement in SNR were measured in fundamental and second harmonic modes respectively. An NIH grant was submitted based on these preliminary results.
DTIC
*Ultrasonics; Transducers; Excitation; Imaging Techniques; In Vitro Methods and Tests*

**20020018049** California Univ., San Francisco, CA USA
**The Cellular Targets Estrogen in Mammary Ductal Development** ***Annual Report, 1 Jun. 2000-31 May 2001***
Kushner, Peter J.; Jun. 2001; 31p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-99-1-9109
Report No.(s): AD-A396965; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It is known that the actions of estrogen in mammary development are mediated primarily by the estrogen receptor alpha but it is not known which estrogen receptors. those in stroma or those in epithelium mediate mammary development. Our purpose is to probe this question by constructing transgenic mice in which wild type human estrogen receptor (hER) and mutants of the receptor that are super- active either at the classical ERE or alternative AP-1 pathway are selectively expressed in epithelium or stroma. A further purpose is to explore the importance of the AP-I versus the classical pathway in estrogen effects on ductal development. In the first year of this project we have constructed %vectors for expression of wild type and mutant human estrogen receptors in the mammary epithelium of transgenic mice, and have made a pilot study of the effects of expressing these receptors in the reproductive epithelium of transgenic mice.
DTIC
*Estrogens; Epithelium; Mice*

**20020018050** California Univ., Los Angeles, CA USA
**Peptide Antiestrogens for Human Breast Cancer Therapy** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Pietras, Richard J.; Jul. 2001; 25p; In English
Contract(s)/Grant(s): DAMD17-99-1-9099
Report No.(s): AD-A396963; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Estrogen binds specific receptors that are present in 60-70% of breast cancers. The estrogen receptor (ER) is a phosphoprotein that regulates transcription and growth by binding estrogen response elements (ERE) in DNA. Inactive ER is a monomer that forms dimers on estrogen-induced phosphorylation. Transcriptional activity of ER is regulated by distinct conformational states resulting from ligand binding, and the induced signal complex recruits steroid receptor coactivator proteins, such as SRC- 1, that are essential for growth. Peptides modeled from interacting sites of ER proteins may selectively inhibit ER signaling and act as antiestrogens. to test this hypothesis, we prepared small peptides to mimic a highly conserved ER sequence including tyrosine-537 and surrounding leucine residues. Peptide antiestrogens, but not control peptides, block ER association with SRC-1 and disrupt binding of ER to ERE. In in vitro studies, estradiol stimulates breast cell growth, and this estrogen effect is blocked by peptide

antiestrogens conjugated with Antennapedia carrier but not by control peptides. Using in vivo tumor xenografts, treatment of nude mice with peptide antiestrogens shows significant activity in arresting growth of estrogen-dependent breast tumors. This work provides target validation but also shows that peptide drugs are difficult to administer.
DTIC
*Peptides; Estrogens; Cancer; Cell Division; Phosphorylation*

**20020018052** South Carolina Univ., Columbia, SC USA
**Quasi-Prospective Study of Breast Cancer and Diet** ***Annual Report, 17 Jul. 2000-16 Jul 2001***
Hebert, James R.; Aug. 2001; 208p; In English
Contract(s)/Grant(s): DAMD17-00-1-0327
Report No.(s): AD-A396952; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
This study aims to refine estimates of the effect of diet on breast cancer. Besides diet we will measure adult weight history and physical activity in women undergoing a diagnostic work-up for breast cancer. The primary dietary focus is on the role of fat consumption in increased risk and certain fruits, vegetables, and grains that may be protective. High weight gain and physical inactivity, both potentially related to increased risk, also will be examined. Approximately 30,000 women will receive routine mammograms for the first time in the Breast Care Centers of the Palmetto Health Alliance/South Carolina Cancer Center (B CC) (at both the Baptist and Richland Campuses and their satellite clinics) over a 36-month recruitment period. We project that a total of about 3,240 women will be eligible and willing to participate, of whom one-fifth (n=648) will have primary breast cancer. All instruments and most study protocols are finalized. Participant recruitment, leading to subject accrual and increased understanding of patient flow through the clinical systems is on-going. Study results will increase our understanding of the effects of diet, adult weight gain, and physical activity on the development of breast cancer and will lead to refining recommendations for its primary prevention.
DTIC
*Cancer; Clinical Medicine; Diets; Prevention*

**20020018057** California Univ., Los Angeles, CA USA
**Membrane Estrogen and HER-2 Receptors in Human Breast Cancer** ***Annual Report, 1 Jul. 2000-1 Jul 2001***
Pietras, Richard J.; Jul. 2001; 27p; In English
Contract(s)/Grant(s): DAMD17-00-1-0177
Report No.(s): AD-A396895; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Patients with breast cancers that express estrogen receptor (ER) commonly receive antiestrogen therapy. The efficacy of this treatment depends on close regulation of breast growth by estrogen. However, as breast cancers progress, they often become resistant to estrogens, and most patients no longer respond to antiestrogen therapy. New antiestrogen treatment options are needed, and alternative therapies may derive from findings showing that some ER molecules occur in plasma membranes of breast cancer cells and interact with transmembrane HER-2 growth factor receptors. Expression of HER-2 receptors occurs in many breast cancers, and the protein kinase activity of HER-2 may modulate ligand-independent activation of ER. If active cross-communication between ER and HER-2 receptor occurs and leads to promotion of cancer growth, this axis may offer a new target for therapeutic intervention. We are assessing the nature of membrane ER and its rote in promoting the growth of breast cancers. From this work, we hope to develop new treatment options to prevent cancer progression in models of human breast cancer. Since overexpression of HER-2 receptor in breast cancer is associated with failure of antiestrogen therapy in the clinic, understanding the biologic basis of associations between membrane ER and HER-2 receptors may help to improve patient management and enhance survival.
DTIC
*Estrogens; Mammary Glands; Cancer*

**20020018058** Ohio State Univ., Columbus, OH USA
**A Novel Phosphatase Gene on 10q23, MINPP, in Hereditary and Sporadic Breast Cancer** ***Annual Report, 1 Aug. 2000-31 Jul. 2001***
Eng, Charis; Aug. 2001; 19p; In English
Contract(s)/Grant(s): DAMD17-00-1-0390
Report No.(s): AD-A396894; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
PTEN is a tumor suppressor gene on 10q23 and encodes a dual specificity phosphatase. One of the major substrates for PTEN is phosphotidylinositol (3,4,5) triphosphate in the PI3 kinase pathway. When PTEN is dysfunctional or absent, P-Akt is high and hence, anti-apoptotic. PTEN is a major susceptibility gene for Cowden syndrome (CS), a hereditary disorder with a high risk of

breast and thyroid cancer, and appears to be involved in a broad range of tumors. In addition, germline PTEN mutations have been found in a developmental disorder, Bannayan-Riley-Ruvalcaba syndrome (BRR) as well. This is an autosomal dominant disorder characterised by macrocephaly, lipomatosis, hemangiomatosis and speckled penis. Previously not thought to be associated with cancer risk, BRR families and cases with germline PTEN mutations have recently been shown to be at risk for cancers and especially breast tumors. Between 10-80% (mean 60%) of CS families and 60% of BRR individuals have germline PTENmutations. Families that do not have germline PTEN mutations are not inconsistent with linkage to the 10q22-23 region. Thus, genes with related function to PTEN in the 10q21-q25 region are good candidates genes for PTEN mutation negative CS, BRR and related sporadic tumors, eg, those of the breast and thyroid. MINPPI lies no more than 1 Mb upstream of PTEN and encodes an inositol polyphosphate phosphatase. In Year 1 of this award, the PI has ascertained 14 unrelated CS probands, 22 BRR probands and 20 CS-like probands known not to harbor germline PTEN mutations. to date, they have not been found to carry germline MINPPI mutations. We found 4 malignant and 3 benign thyroid tumors to harbor deletion or intragenic mutation of MINPPI. More interestingly, IVS3+34T>A was found in about 15% of FA cases and normal controls but not in patients with FTC.
DTIC

*Genetics; Mammary Glands; Cancer*

**20020018152** California Univ., Berkeley, CA USA

**Functional Analysis of a Novel Transcription Factor that is Amplified and Overexpressed in Breast Cancers** ***Annual Report, 1 Sep. 1999-31 Aug. 2000***

Yaswen, Paul; Sep. 2000; 14p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-98-1-8065

Report No.(s): AD-A396851; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The candidate oncogene ZNF2l7, predicted to encode alternately spliced Kruppel-like transcription factors, was originally identified based on its core location in an amplicon on chromosome 2Oq13.2 in breast cancer cell lines and primary tumors, and its recurrent pattern of expression in tumors. to understand how ZNF2l7 overexpression contributes to breast cancer progression, in vitro studies are being performed to determine how ZNF2l7 alters the phenotype of human mammary epithelial cells (HMEC). Initially, we investigated the functional consequences of ZNF2l7 overexpression by transducing the gene into finite lifespan HMEC. In five independent experiments, ZNF2l7-transduced cultures maintained growth beyond the point where control cells senesced. HMEC that overcame senescence initially exhibited heterogeneous growth and continued telomere erosion, followed by increasing telomerase activity, stabilization of telomere length, and resistance to TGFbeta growth inhibition. This pattern is similar to that observed in rare HMEC lines immortalized following exposure to a chemical carcinogen, where telomerase reactivation and attainment of good uniform growth occurred in an incremental, apparently epigenetic manner, a process we have termed ”conversion,” as a consequence of overcoming senescence. Aberrant expression of ZNF217 may be selected for during breast cancer progression because it allows breast cells to overcome senescence and attain immortality.
DTIC

*Epithelium; Mammary Glands; Cancer; In Vitro Methods and Tests; Chromosomes*

**20020018154** Chicago Univ., Chicago, IL USA

**Molecular Markers in Hereditary Breast Cancer** ***Annual Report, 15 Sep. 1999-14 Sep 2000***

Olopade, Olufunmilayo I.; Oct. 2000; 6p; In English

Contract(s)/Grant(s): DAMD17-99-1-9123

Report No.(s): AD-A396849; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The promise of research into breast cancer genetics is that it will provide us with new insights into the etiology of breast cancer that can be translated to strategies for early diagnosis and treatment for the larger population of women who develop breast cancer without having a genetic predisposition. An academic award represents an outstanding opportunity for me to critically appraise the emerging role of genetics in clinical breast cancer care and forge new avenues of research. Toward this goal, I plan to accomplish the following during the award period: (1) perform a thorough review of the cytogenetic and molecular genetics literature to identify potential chromosomal regions that may harbor genes whose abnormal function is critically involved in the development of breast cancer; (2) develop a robust panel of markers that can be used for clinical correlative studies of hereditary breast cancers; (3) develop a tissue repository composed of biological specimens from 500 patients with inherited breast cancer (e.g fresh frozen tumor specimens, or paraffin embedded tumor specimens and normal blood lymphocytes, DNA and sera whenever possible). These studies will lead to an improved understanding of the biology of breast cancer which will ultimately translate into more effective therapies.
DTIC

*Mammary Glands; Cancer; Etiology; Molecular Biology; Genetics*

**20020018155** Wisconsin Univ., Madison, WI USA

**Mechanisms through which Rat Mammary Gland Carcinogenesis is Preferentially Initiated by H-Ras over K-Ras Signaling Pathways** ***Annual Report, 1 Jul. 1999-30 Jun. 2000***

McFarlin, Daniel; Jul. 2000; 8p; In English

Contract(s)/Grant(s): DAMD17-98-1-8357

Report No.(s): AD-A396847; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This research distinguishes mechanisms through which activated Ras initiates rat mammary gland carcinogenesis. Experiments expressing H-Ras and K-Ras chimeric proteins in mammary gland (Aim lA) investigate hypothesis one: differential rat mammary gland carcinogenesis results from differences in the last 20 amino acids of 11-Ras and K-Ras K-Ras with an H-Ras c-terminus seems as tumorgenic as H- Ras, supporting hypothesis one: however, 11-Ras with an K-Ras c-terminus also seems as tumorgenic as H-Ras,suggesting a unique characteristic of intact K-Ras reduces mammary carcinogenesis. - Expression of Raf-Caax (Aim 1B), does not cause tumors, suggesting hypothesis two: no individual Ras effector will initiate transformation, rather multiple effectors must synergise. Expressing Ras effector loop mutants (ELM), (Aim 2A), weakens hypothesis two. Each Ras ELM (G37 activates RalGDS, E38 activates Raf, and C40 activates Pl3K), individually causes tumors. E38-Ras, which activates Raf, is tumorgenic-yet Raf-Caax is not. These results suggested E38 Ras is activating an additional effector pathway(s), or that Raf-Caax is defective for in situ tumor formation. Early result tumor formation from a-terminus truncated Raf (deltaRaf) shows Raf-Caax is defective, and eliminates hypothesis two.

DTIC

*Mammary Glands; Cancer; Proteins*

**20020018160** Colorado Univ., Colorado Center for Astrodynamics Research, Boulder, CO USA

**Relationships Between the Bulk-Skin Sea Surface Temperature Difference, Wind, and Net Air-Sea Heat Flux** ***Final Report***

Emery, William J., Colorado Univ., USA; Castro, Sandra L., Colorado Univ., USA; [2002]; 15p; In English

Contract(s)/Grant(s): NAG5-7365; NAGW-1110; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary purpose of this project was to evaluate and improve models for the bulk-skin temperature difference to the point where they could accurately and reliably apply under a wide variety of environmental conditions. To accomplish this goal, work was conducted in three primary areas. These included production of an archive of available data sets containing measurements of the skin and bulk temperatures and associated environmental conditions, evaluation of existing skin layer models using the compiled data archive, and additional theoretical work on the development of an improved model using the data collected under diverse environmental conditions. In this work we set the basis for a new physical model of renewal type, and propose a parameterization for the temperature difference across the cool skin of the ocean in which the effects of thermal buoyancy, wind stress, and microscale breaking are all integrated by means of the appropriate renewal time scales. Ideally, we seek to obtain a model that will accurately apply under a wide variety of environmental conditions. A summary of the work in each of these areas is included in this report. A large amount of work was accomplished under the support of this grant. The grant supported the graduate studies of Sandra Castro and the preparation of her thesis which will be completed later this year. This work led to poster presentations at the 1999 American Geophysical Union Fall Meeting and 2000 IGARSS meeting. Additional work will be presented in a talk at this year's American Meteorological Society Air-Sea Interaction Meeting this May. The grant also supported Sandra Castro during a two week experiment aboard the R/P Flip (led by Dr. Andrew Jessup of the Applied Physics Laboratory) to help obtain additional shared data sets and to provide Sandra with a fundamental understanding of the physical processes needed in the models. In a related area, the funding also partially supported Dr. William Emery and Daniel Baldwin in the preparation of their publication "Accuracy of in situ sea surface temperatures used to calibrate infrared satellite measurements". The remainder of this report is drawn from these publications and presentations.

Author

*Oceans; Parameterization; Sea Surface Temperature; Temperature Gradients; Thermal Stresses*

**20020018612** Maryland Univ., Baltimore, MD USA

**Regulatory Control of Breast Tumor Cell Poly (ADP-Ribose) Polymerase** ***Annual Report, 1 Aug. 2000-31 Jul. 2001***

Han, Suhua; Malkas, Linda; Aug. 2001; 35p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0324

Report No.(s): AD-A397014; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Poly (ADP-ribose) polymerase (PARP) is a component of the DNA synthetic apparatus of cells, (i.e., the DNA synthesome). PARP is involved in the process of DNA replication, DNA repair, and cellular transformation. At least 15 components of the DNA synthesome are poly (ADP-ribosylated), which suggests that PARP may play a regulatory role in controlling the activity and the fidelity of the DNA synthesome of breast cancer cells. We also observed that the level of PARP activity found in breast cancer

cells is below that found in non-malignant breast cells. We have also confirmed that PARP is a component of the DNA synthesome by both MALDI and quadrapole-time of flight (Q-TOF) mass spectrometry. We also observed PARP to be more highly expressed in the breast cancer cells, despite a lower overall activity. It is our goal to establish a clear link between the differences in the activity of PARP and the alteration(s) in structure exhibited by this protein in both malignant and non-malignant breast cells.
DTIC
*Mammary Glands; Cancer; Deoxyribonucleic Acid*

**20020018617** Long Island Jewish Medical Center, New Hyde Park, NY USA
**Breast Cancer Prevention by Hormonally Induced Mammary Gland Differentiation: The Role of a Novel Mammary Growth Inhibitor and Differentiation Factor MRG** ***Annual Report, 1 Oct. 1999-30 Sep. 2000***
Shi, Y. E.; Oct. 2000; 16p; In English
Contract(s)/Grant(s): DAMD17-99-1-9255
Report No.(s): AD-A396887; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We have previously identified and characterized a novel tumor growth inhibitor and a fatty acid binding protein in human mammary gland and named it as Mammary derived growth inhibitor Related Gene MRG. MRG has tumor-suppressing activities; it inhibits breast cancer cell growth in vitro and tumor growth in vivo. Here, the effects of MRG on mammary gland differentiation and its interaction with omega-3 polyunsaturated fatty acids (omega-3 PUFA) on growth inhibition were investigated. MRG protein expression was associated with human mammary gland differentiation with the highest expression observed in the differentiated alveolar mammary epithelial cells from the lactating gland. Overexpression of MRG in human breast cancer cells induced differentiation with changes in cellular morphology and a significant increase in the production of lipid droplets. Treatment of mouse mammary gland in organ culture with MRG protein resulted in a differentiated morphology and stimulation of beta-casein expression. Treatment of human breast cancer cells with omega-3 PUFA DRA resulted in a differential growth inhibition proportional to their MRG expression. MRG transfected cells or MRG protein treated cells were much more sensitive to DHA-induced growth inhibition compared with MRG negative or control non-treated cells. Our results suggest that MRG is a candidate mediator of the differentiating effect of pregnancy on breast epithelial cells and may play a major role in omega-3 PUFA-mediated tumor suppression.
DTIC
*Mammary Glands; Cancer; Genes*

**20020018874** University of South Florida, Tampa, FL USA
**The CAD Method for Microcalcification Detection: Independent of Sensor and Resolution** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Quian, Wei; Jul. 2001; 17p; In English
Contract(s)/Grant(s): DAMD17-99-1-9374
Report No.(s): AD-A397029; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The aims of this- work are to explore the feasibility of developing a new class of computer assisted diagnostic (CAD) methods for microcalcification cluster (MCC) detection for breast cancer screening using digital mammography. The objectives are to achieve: (a) improved CAD performance that is significantly more robust for large image databases, and (b) an adaptive CAD method that is independent of the digital sensor resolution and gray scale characteristics; for the first time. The proposed method is novel in concept and is based on pioneering experience in development of adaptive CAD algorithms including linear wavelet transforms and non linear transforms for improved feature extraction, their implementation of filter banks that uniquely allow adaptive approaches, and experience in specialized multi-stage neural networks for detection of MCC's with different feature input strategies. The intent is to compare existing wavelet methods to the proposed new method and evaluate them for a common case data base using a state of the art direct digital detector and film (three digitizers)
DTIC
*Cancer; Calcification; Computer Aided Design; Computer Techniques*

**20020019011** Texas Univ., M. D. Anderson Cancer Center, Houston, TX USA
**Novel Peptide/Protein Delivery System Targeting erbB2-Overexpressing Breast Cancer Cells** ***Annual Report, 1 Aug. 2000-31 Jul. 2001***
Yu, Dihua; Aug. 2001; 20p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-99-1-9271
Report No.(s): AD-A397007; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It has been well recognized that the next frontier in molecular medicine is the delivery of therapeutics. Among the biological therapeutics, peptides/proteins are especially difficult and challenging to deliver. A peptide sequence localized within a 13-amino acid domain of Tat (named penetratin), when linked to other peptides or proteins, was able to carry attached peptide or protein into the cells when they were added to cell culture medium. We hypothesized that the unique property of penetratin can be utilized for delivery of therapeutic peptides/proteins. It should be noted that after the funding of this Idea Award, a report published in 'Science' by Steven Dowdy's laboratory demonstrated that penetratin can deliver functional beta-galactosidase protein (120 kD) to all tissues in mice.
DTIC
*Cancer; Mammary Glands; Peptides; Proteins*

**20020019077** Miami Univ., School of Medicine, FL USA
**MUC4 Abrogation of Herceptin Responsiveness in Breast Cancer** ***Final Report, 1 Sep. 2000-1 Sep 2001***
Carraway, Kermit L.; Oct. 2001; 19p; In English
Contract(s)/Grant(s): DAMD17-00-1-0685
Report No.(s): AD-A396930; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Muc4 is a heterodimeric glycoprotein complex consisting of a peripheral mucin subunit tightly but noncovalently linked to a transmembrane subunit. Muc4 is overexpressed on a number of human breast tumors. Overexpression of Muc4 has been shown to block cell-cell and cell-matrix interactions, protect tumor cells from immune surveillance and promote metastasis. In addition, Muc4 has been shown to act as a ligand for ErbB2/HER2, the target of the therapeutic antibody Herceptin. Using A375 melanoma and MCF7 breast adenocarcinoma cells stably transfected with tetracycline regulatable Muc4, we have investigated whether its overexpression can repress antibody binding to cell surface-expressed ErbB2.
DTIC
*Cancer; Tetracyclines; Antibodies*

**20020019079** Miami Univ., FL USA
**Electrophysiological Changes in NF1** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***
Fieber, Lynne A.; Sep. 2001; 18p; In English
Contract(s)/Grant(s): DAMD17-99-1-9578
Report No.(s): AD-A396925; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
An important component of Schwann cell (SC) physiology, which has remained relatively unknown in NF1, is the electrophysiology of affected cells and the relationship of ion currents to development and maintenance of the NF1 SC phenotype. We are studying the relationship between a K channel current, functionally expressed in NF1 SC (Fieber 1998; this report), and SC proliferation. Ion channels are membrane proteins that mediate electrical communication between cells of the nervous system and are vital to nervous system function. This K channel is opened in response to depolarizations of the cell membrane, which could occur in myelinating SC via excitatory discharge of the SC- ensheathed axon. There is evidence that suggests that these K currents are directly related to the proliferative capacity of many cell types and have a relationship to well characterized second messenger pathways that play a role in the cell cycle during development (Konishi 1990) and the development of certain disease states. by studying the K currents of NFl SC and their relationships to 1) growth factors found to be abnormally expressed in human NF1 SC, 2) known second messengers that can be measured or manipulated, and 3) proliferation, and by making relevant comparisons to these features in normal SC, we hope to provide insights about the tumorigenic process in NFl. The purpose of this study is to examine the inter-relationships between K channels, ras, and neurofibromin in SC proliferation.
DTIC
*Nervous System; Electrophysiology; Membranes; Proteins*

**20020019080** Rochester Univ., NY USA
**Androgen Regulation of Human Prostate Cell Growth** ***Final Report, 1 Jan. 1999-30 Jun. 2001***
Harrison, Robert W., III; Jul. 2001; 9p; In English
Contract(s)/Grant(s): DAMD17-99-1-9023
Report No.(s): AD-A396909; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Although treatment of prostate cancer by androgen withdrawal has been an established treatment for decades, the molecular basis for androgen-dependent prostate growth is unclear. Since androgen effects are mediated through changes in gene expression, the molecular basis for prostate cancer regression upon androgen withdrawal and eventual escape from withdrawal would be better understood if the genes regulated by androgen in the prostate were known. This laboratory had developed a method of identifying hormone-regulated genes by "trapping" (Harrison & Miller, Endocrinology 137:2758, 1996), using a selectable transgene lacking

a functional promoter. After stable transfection, a two-stage selection is performed and only cells containing a transgene that has usurped the functions of a native, regulated promoter are left alive. The flanking, native DNA is then sequenced by gene-walking (Harrison et al, Biotechniques. 22:650-3, 1997). Over 100 LNCXAP clones have been isolated of which 80 contain trapped, down-regulated genes and 30 contain trapped, up-regulated genes. Initial walks have been performed on a total 20 DNA samples of which one is homologous to a gene not previously described as androgen-regulated. This gene has homology with known protein synthesis initiation factors and thus, may play a supporting role in androgen stimulation of prostate protein synthesis.
DTIC
*Prostate Gland; Biosynthesis; Cell Division; Gene Expression; Cloning (Biology)*

**20020019410** General Accounting Office, Washington, DC USA
**Investigative Techniques: Federal Agency Views on the Potential Application of "Brain Fingerprinting"**
Grassley, Charles E.; Oct. 2001; 27p; In English
Report No.(s): AD-A397206; GAO-02-22; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Brain Fingerprinting is a proposed investigative technique that incorporates the use of a test administered to a subject that consists of specific information related to a particular event or activity. According to its developer, the technique requires a sufficient amount of specific information about the event or activity that would be known only to the perpretrator and the investigator. The developer has indicated, therefore, that Brain Fingerprinting is not designed as a screening tool-a function that involves questioning a subject about events unknown to the investigator. In administering the Brain Fingerprinting test, a subject is shown a sequence of various stimuli on a computer screen in the form of words, phrases, or pictures-some that are related to the event or activity and others that are Irrelevant. An electroencephalograph (EEG)2 records the subject's electrical brain activity, which appears as a waveform. The technique employs a statistical method to analyze the components of the waveform to determine whether or not the subject recognizes the information. According to the developer, an investigator would be able to use this information as evidence for or against a suspect. For example, the developer has indicated that the technique could be used to determine whether a suspect has knowledge of details about a crime.
DTIC
*Electroencephalography; Brain; Law (Jurisprudence); Governments*

**20020019561** Tennessee Univ., Memphis, TN USA
**Assessment of the Activation of Rho Family GTP-Binding Proteins in Breast Cancer Cells and Specimens** ***Annual Report***
Zheng, Yi; Aug. 2001; 112p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-00-1-0454
Report No.(s): AD-A397083; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Rho GTPases have begun to be appreciated to play roles in breast carcinogenesis. to establish a causal link between activation of individual Rho signaling events and certain aspects of breast cancer development, we have started to search for direct effect on Rho GTPases in mitogenic conditions and in various physiological situations that may be connected to mammary cell transformation. As stated in this first annual report, we have established a method using the Rho GTPase-interactive effector domains of WASP, PAK1, and Rhotekin to quantitatively define the activation-states of Rho family members CDC42, Rac, and Rho in cells, and applied this method to four cellular conditions which are related to mammary tumorigenesis. These studies are significant since the findings further confirmed the involvement of Rho GTPases in diverse physiological situations that may contribute to oncogenesis, and have paved the way for us to examine the endogenous Rho family GTPases in mitogen-stimulated or oncogene-transformed mammary cells and in breast cancer specimens. The results obtained also strengthened our working hypothesis that certain Rho GTPases are activated in breast cancer cells and tissues and that exploration of the role Rho proteins in breast may lead to novel anti-cancer therapeutics.
DTIC
*Mammary Glands; Cancer*

**20020019800** Army Command and General Staff Coll., Fort Leavenworth, KS USA
**Telemedicine for the Canadian Forces: What Is a Viable Satellite Means for the Canadian Forces to Deliver Telemedicine Information Between a Deployed Force and a Canada Based Supporting Hospital**
Walrod, Timothy W.; Jun. 01, 2001; 74p; In English; Original contains color images
Report No.(s): AD-A397226; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Several nations currently use commercial off-the-shelf technology to provide telemedicine for military and civilian purposes. The vast distances and undeveloped regions that the Canadian Forces (CF) work across requires a transportable, satellite accessible telemedicine system that meets their requirements. The purpose of this thesis was to conduct an exploratory descriptive

analysis to compare existing deployable telemedicine systems and identify which of those would best meet the telemedicine requirements of the CF as a viable satellite means for the CF medical community to deliver telemedicine information between a deployed force and a Canada based supporting hospital. A comparative analysis was completed in order to recommend a telemedicine system that the CF can implement and deploy with. of the three systems analyzed, all are viable in a comparison of systems using a non-weighted set of criteria. The capabilities and limitations of a system such as cost, weight, and bandwidth can be compared individually and as an overall system. All three telemedicine systems studied are viable satellite means that the CF can use to deliver telemedicine information. The CF can now tailor a satellite delivered telemedicine system that meets the most important criteria of their requirements.
DTIC
*Canada; Deployment; Telemedicine; Communication Satellites; Medical Services*

**20020019808** Air Univ., Maxwell AFB, AL USA
**Executive Health Care in the Air Force**
Simpson, Carl G.; Apr. 1998; 70p; In English
Report No.(s): AD-A397186; AU/AWC/RWP221/98-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
It is often assumed by most military and civilians that flag-ranking officers, and their families, enjoy privileged health care, both accession and quality of care. As an experienced physician in charge of a Major Command's Executive Health Program, the author's experience is far from that perceived and assumed. In fact, quite the opposite prevails. Although there are "Executive Wellness" and "Health" programs in existence in the USAF, there is clear lack of doctrine and awareness of such programs. The result is less-than-optimal health care delivery to flag-ranking officers and their families. In some instances, inferior to that provided to the lowest ranking individual in the service. The article goes on to explore the origin of executive health care, case studies highlighting major medical errors committed with analyses that follow, a broad look at world-class executive establishments, and finally, a proposal for an executive health care system for the USAF in the 21st century.
DTIC
*Armed Forces (USA); Air Defense; Public Health*

**20020019812** Medical Univ. of South Carolina, Charleston, SC USA
**Complement Inhibitory Proteins and Their Role in Tumorigenesis** ***Annual Report, 1 Sep. 2000-31 Aug. 2001***
Tomlinson, Stephen; Sep. 2001; 38p; In English
Contract(s)/Grant(s): DAMD17-99-1-9325
Report No.(s): AD-A397094; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Complement is a major effector mechanism of the immune system. Membrane complement inhibitors on the surface of breast tumor cells, may play a crucial role in determining tumorigenesis and the outcome of antibody-mediated immunotherapy. The objective of this proposal is to determine the role of complement and complement inhibitors in tumorigenesis and to determine whether reversing the effects of tumor-expressed complement inhibitors will allow effective immune-mediated clearance of tumor cells. We have established rodent models of human cancer that are suitable for evaluating the role of complement and complement inhibitors in the growth and control of breast cancer (and is likely applicable to many types of cancer). We have shown for the first time in vivo that a complement inhibitor expressed on a tumor cell surface can promote tumor growth, and have shown that different complement associated effector mechanisms can operate to control tumor growth.
DTIC
*Mammary Glands; Cancer*

**20020019813** Washington State Univ., Pullman, WA USA
**Blocking HER-2-Mediated Transformation with a Dominant Negative Form of HER-3** ***Annual Report, 1 Jun. 2000-30 May 2001***
Ram, Tracy G.; Jun. 2001; 51p; In English
Contract(s)/Grant(s): DAMD17-00-1-0490
Report No.(s): AD-A397093; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Amplification of the HER-2 gene often leads to breast cancer by causing cells to make abnormally high levels of the wild-type HER-2 protein. Evidence now shows that the interaction between HER-2 and HER-3 leads to the constitutive activation of HER-2/HER-3 heterodimers in breast cancer cells with HER-2 gene amplification, and HER-2/HER-3 potently activates multiple signal transduction pathways involved in mitogenesis. This indicates that inhibition of the interaction between HER-2 and HER-3 may be an especially effective and unique strategy for blocking the effects of HER-2 in human breast cancer cells. Therefore, we

constructed a bicistronic retroviral expression vector that codes for a dominant negative form of HER-3 that can inactivate the function of HER-2/HER-3.
DTIC
*Mammary Glands; Cancer*

**20020020662** NASA Marshall Space Flight Center, Huntsville, AL USA
**The Effect of Solution Thermal History on Chicken Egg White Lysozyme Nucleation**
Burke, Michael W., Alabama Univ., USA; Judge, Russell A., Alabama Univ., USA; Pusey, Marc L., NASA Marshall Space Flight Center, USA; Journal of Crystal Growth; [2001]; ISSN 0022-0248; Volume 232, pp. 301-307; In English
Contract(s)/Grant(s): RTOP 101-11-32; Copyright; Avail: Issuing Activity

Proteins are highly flexible molecules and often exhibit defined conformational changes in response to changes in the ambient temperature. Chicken egg white lysozyme has been previously shown to undergo an apparent structural change when warmed above the tetragonal/orthorhombic phase transition temperature. This is reflected by a change in the habit of the tetragonal and orthorhombic crystals so formed. In this study, we show that possible conformational changes induced by heating are stable and apparently non-reversible by simple cooling. Exposure of protein solutions to temperatures above the phase change transition temperature, before combining with precipitant solution to begin crystallization, reduces final crystal numbers. Protein that is briefly warmed to 37 C, then cooled shows no sign of reversal to the unheated nucleation behavior even after storage for four weeks at 4 C. The change in nucleation behavior of tetragonal lysozyme crystals, attributed to a structural shift, occurs faster the greater the exposure to temperature above the equi-solubility point for the two phases. Heating for 2 hours at 48 C reduces crystal numbers by 20 fold in comparison to the same solution heated for the same time at 30 C. Thermal treatment of solutions is therefore a possible tool to reduce crystal numbers and increase crystal size. The effects of a protein's previous thermal history are now shown to be a potentially critical factor in subsequent macromolecule crystal nucleation and growth studies.
Author
*Eggs; Heating; Lysozyme; Nucleation; Temperature Effects*

**20020020977** Royal Prince Alfred Hospital, Sydney, Australia
**Promoter Regions Determining Over-expression of Metalloproteinase Genes in Breast Cancer** ***Final Report, 1 Jul. 1997-30 Jun. 2001***
Lyons, James; Jul. 2001; 38p; In English
Contract(s)/Grant(s): DAMD17-97-1-7106
Report No.(s): AD-A397050; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The aim of this project is to determine which parts of the matrix metalloproteinase (MMP) genes cause those genes to be over-expressed in breast cancer, contributing to invasion and metastasis. It was determined that breast cancer cells can be classified into two types: one type retains its epithelial characteristics, the other has lost them by undergoing an epithelial-mesenchymal transition (EMT). The MMPs in each cell type are up-regulated by distinct molecular mechanisms. Gelatinase B is produced at an unusually high level by the epithelial cells, requiring no stimulus from the other cell type. In contrast, the cells that have undergone an EMT up-regulate their MMPs in response to a factor secreted by the epithelial cells. Using MMP promoters linked to measurable reporter genes, it was determined that the constitutively high levels of gelatinase B production are mediated through the region upstream of the proximal promoter, whereas the high inducible levels of MMP production in the cells that have undergone an EMT are not mediated through the upstream regions. Thus, the mechanism determining high MMP production by breast cancer cells depends on the state of differentiation of the cells.
DTIC
*Mammary Glands; Cancer; Genetics*

**20020020979** Texas Univ., M. D. Anderson Cancer Center, Houston, TX USA
**Cyclin E as a Prognosticator for Nde Negative, Stage II Breast Cancer** ***Final Report, 1 Sep. 2000-31 Aug. 2001***
Keyomarai, Khandon; Oct. 2001; 10p; In English
Contract(s)/Grant(s): DAMD17-00-1-0629
Report No.(s): AD-A397030; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Our laboratory has made the novel observation that cyclin E is overexpressed and present in lower molecular weight (LMW) isoforms in selected breast cancer cells and tumor tissues. in a retrospective analysis of tumor specimens from 403 breast cancer patients, we previously discovered that overexpression of LMW isoforms cyclin E strongly correlated with the development of distant metastases and poor overall survival. With a median follow-up of 4-years 91.7% of breast cancer cases with cyclin E overexpression developed distant metastases compared to 7% of cases without cyclin E overexpression (p is less than 0.001). We

also found that in 126 patients with Stage I breast cancer, cyclin E overexpression had a 100% predictive value for the development of metastatic disease. Based on this retrospective work, our goal for this award was to initiate a PROSPECTIVE study assessing the importance of cyclin E overexpression as a negative predictor of outcome in Stage I and II breast cancers. We have been able to accrue over 120 diagnosed with Stage I and II disease, obtained normal and tumor tissue from these patients and subjected them to western blot analysis with cyclin E antibody. We will do follow-up on these patients for the next 3-5 years and correlate the expression of cyclin E to outcome at the end of the follow-up period.
DTIC
*Mammary Glands; Cancer*

**20020020980** Lawrence Livermore National Lab., Livermore, CA USA
**Repair Machinery for Radiation-Induced DNA Damage** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Wilson, David; Jul. 2001; 82p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-99-1-9252
Report No.(s): AD-A397028; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Understanding the repair mechanisms for ionizing radiation (IR)-induced DNA damage and having prior knowledge of a patient 5' 1K-specific repair capacity will help determine which patients will be most responsive to radiation therapy and design more affective treatment regimes. The objective of this work has been to define the contributions of the mammalian protein Apel, and other candidate nucleases, to the repair of IR-induced genetic damage. We are currently constructing cell lines that lack Apel protein and will determine the sensitivity of these mutant cells to various DNA-damaging agents, e.g. IR. In the course of these studies, we generated a mammalian cell line that overexpresses Apel-i-fold (AAS-Apel) . In combination with previous findings, our data indicates that Apel activity is not a good prognostic indicator for sensitivity to the alkylating agent methyl methanesulfonate or the oxidizing agent hydrogen peroxide, but may in some circumstances be for IR and bleomycin. Moreover, the AA8-Apel line displays -l.7 fold elevated resistance to the replication-blocking nucleoside analog dioxolane cytidine, a slightly increased resistance to azidothymidine, but normal sensitivity to arabinosylcytosine and 2',3'-dideoxy-2',3'-dihydrothymidine. This is the first cell-based study demonstrating a role for Apel in influencing cellular resistance to anti-cancer/ viral antimetabolites. Additionally, we completed the biochemical characterization of two protein factors, human Sfn and Hem45/Isg20, and have found that these proteins are unlikely involved in repairing IR-induced DNA damage. It thus appears that Apel is a predominant repair factor for 3' -damages, although alternative corrective mechanisms exist. Future studies will focus more on obtaining a quantitative determination of the overall contribution of Apel to 3' -damage repair and IR protection.
DTIC
*Deoxyribonucleic Acid; Ionizing Radiation; Radiation Damage; Radiation Therapy; Mammary Glands; Cancer*

## 52
## AEROSPACE MEDICINE

*Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science. For the effects of space on animals and plants see 51 Life Sciences.*

**20020016113** Pennsylvania State Univ., Coll. of Medicine, Hershey, PA USA
**Neoplastic Consequences of a Mutator Phenotype in Human Breast Epithelial Cells: A Prospective Analysis** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Eckert, Kristin A.; Welch, Danny R.; Jul. 2001; 9p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-00-1-0395
Report No.(s): AD-A396659; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have established an ex vivo culture system using MCF-10A cells. The doubling time for this cell line in our laboratory is ^3-5 days. We have determined the cytotoxicity of three antibiotics towards MCF-10A cells. The cells were found to be more sensitive to antibiotics than other cell lines we have used experimentally. The effective concentrations for selection of MCF-10A cells are: zeocin, 300 micrograms/ml; puromycin, 0.5 micrograms/ml; and hygromycin, 40 micrograms/ml. We have standardized our method for transfection (lipofection) of the MCF-10A cells. Two expression vectors for DNA polymerase beta (polbeta) have been constructed: pCDNA4-based and pIRES-based. Stable zeocin-resistant MCF-10A clones were isolated following transfection of pCDNA-polbeta. While endogenous polbeta protein was detected by Western analyses, no exogenous protein was detectable in these clones. Stable selection using the PIRES-beta/pIRESpuro vector pair was only partially successful, as the

MCF-10A, puromycin-resistant clones became senescent. However, Western analyses of polbeta-pIRES transfected MCF-10A cells demonstrated the exogenous expression of His-polbeta in the clones. These results demonstrate that our proposed experiments are feasible. However, the time frame needed to complete the project may be substantially longer than anticipated, due to the slow growth rate of the MCF-10A cell line and sensitivity to antibiotics.
DTIC
*Neoplasms; Mammary Glands; Genetics; Epithelium; Mutations; Culture Techniques*

**20020016114** Purdue Univ., Research Foundation, West Lafayette, IN USA
**Functional Analysis of the ErbB4 Receptor Tyrosine Kinase** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Riese, David J.; Jul. 2001; 118p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-00-1-0416
Report No.(s): AD-A396641; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This IDEA award is supporting our efforts to elucidate the roles that the ErbB4 receptor tyrosine kinase plays in breast cancer. We have generated three constitutively active mutants of ErbB4. Unlike constitutively active ErbB1 or ErbB2 mutants, the constitutively active ErbB4 mutants DO NOT couple to increased cell proliferation, to anchorage independent growth, or to a loss of contact inhibition in rodent fibroblast cell lines. Moreover, at least one of the constitutively active ErbB4 mutants is coupled to inhibition of colony formation in human mammary (tumor) cell lines and to inhibition of mammary (tumor) cell line proliferation. This suggests that ErbB4 is coupled to mammary tumor suppression in vivo.
DTIC
*Mammary Glands; Cancer; Receptors (Physiology)*

**20020016115** Colorado Univ., Health Sciences, Denver, CO USA
**The Physiology of Growth Hormone-Releasing Hormone (GHRH) in Breast Cancer** ***Annual Report, 1 Jun. 2000-31 May 2001***
Zeitler, Philip S.; Jun. 2001; 18p; In English
Contract(s)/Grant(s): DAMD17-00-1-0212
Report No.(s): AD-A396630; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We hypothesize that GHRH functions as an autocrine/paracrine growth factor in neoplastic breast tissue. to address this hypothesis, we are undertaking a comprehensive examination of the physiology of GHRH in immortalized breast cancer cell lines. We report here the results of the first 12 months of this project. The data summarized here indicate that antagonism of the endogenous GHRH autocrine/paracrine system in MDA231 breast cancer cells leads to inhibition of cell proliferation, as well as increased cellular apoptosis, the combination of which leads to decreased cell number. The effect of GHRH antagonism is dose-dependent, transient, and reversible. Furthermore, the results begin to clarify the intracellular pathways involved in the physiology of GHRH in breast cancer cells, implicating P38 kinase and Jun kinase 2, pathways known to be associated with cell proliferation and apoptosis in other tissues. These results are consistent with previous demonstrations of an inhibitory effect of GHRH antagonists on a variety of tumors. Moreover, the results provide initial information regarding the mechanism of action of endogenous GHRH. Continued study of this system should further illuminate the physiology of GHRH in neoplastic tissue, as well as clarifying the therapeutic potential of GHRH receptor antagonists in human neoplasia.
DTIC
*Mammary Glands; Cancer; Pituitary Hormones*

**20020016117** Colorado Univ., Health Sciences Center, Aurora, CO USA
**TRAIL-Induced Apoptosis: A Prostate Cancer Therapy** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Lu, Xiaojun; Rodman, David; Jul. 2001; 18p; In English
Contract(s)/Grant(s): DAMD17-99-1-9516
Report No.(s): AD-A396623; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
TRAIL induces apoptosis in five of six prostate cancer cell lines. The cell line LNCaP is resistant to TRAIL treatment. Highly constitutive expression of AKT was found in LNCaP cells, and suppression of AKT activity by the PI-3 kinase inhibitors wortmanin and Ly 294002 renders LNCaP cells sensitive to TRAIL. Infection of LNCaP cells with a constitutively active AKT reverses the wortmanin effect. Thus, elevated AKT protects LNCaP cells from TRAIL-induced apoptosis. Bcl-2 dimerization varies in six different prostate cell lines. Overexpression of bcl-2 in LNCaP cells inhibits cytochrome c release from mitochondria when TRAIL is used in combination with wortmanin, suggesting that the mitochondria mediated apoptosis pathway is crucial.

The role of mitochondrial superoxide production in TRAIL-induced apoptosis is currently being studied in smooth muscle cells deficient in each superoxide dismutase.
DTIC
*Apoptosis; Cancer; Mitochondria; Prostate Gland; Therapy*

**20020016119** Miami Univ., FL USA
**A New Invasion and Metastasis Molecule, Tiam1 and its Interaction with the Cytoskeleton are Involved in Human Breast Cancer Progression** ***Final Report, 7 Jul. 1997-6 Jul 2001***
Bourguignon, Lilly Y. W.; Aug. 2001; 43p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-97-1-7014
Report No.(s): AD-A396609; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In breast tumor cells (e.g., SP1 cells), the guanine nucleotide exchange factor (GEF, the dbl or DR family), Tiam1 (T lymphoma invasion and metastasis) is detected as a 200 kDa protein. Tiam1 is capable of catalyzing GDP/GTP exchange for Rac1. In particular, the aa393-aa738 sequence of Tiam1, which contains the NH2-terminal pleckstrin homology (PHn), a putative coiled coil region (CC) and an additional adjacent region (Ex) (designated as PHn-CC-Ex domain of Tiam1), is involved in the direct interaction with CD44v3 isoform (the hyaluronan receptor) and ankyrin (the cytoskeletal protein) both in vivo and in vitro. Specifically, the binding of HA to the CD44v3 isoform stimulates Tiam1-specific GDP/GTP exchange for Rho-like GTPases such as Rac1, and promotes cytoskeleton-mediated breast tumor cell migration. Furthermore, we have demonstrated that the PHn-CC-Ex domain of Tiam1 contains an ankyrin binding site. The structural homology between the ankyrin binding domain of Tiam1 (the sequence between aa717 and aa727 within the PHn-CC-Ex domain) and CD44 is quite striking. Most importantly, the Tiam1-ankyrin interaction also promotes Rac1 activation and breast tumor cell migration. These observations clearly indicate that Tiam1 contains multiple functional domains (e.g., a CD44-specific membrane localization site and a cytoskeleton binding region for ankyrin) required for the regulation of Tiam1-Rac1 signaling and cytoskeleton function during metastatic breast tumor progression.
DTIC
*Cells (Biology); Mammary Glands; Tumors; Cancer; Proteins*

**20020016120** Army Research Inst. of Environmental Medicine, Thermal and Mountain Medicine Div., Natick, MA USA
**Environmental Medicine Genome Bank (EMGB): Current Composition**
Messinese, Nicholas J.; Sheldon, Holly K.; Lilly, Craig M.; Sonna, Larry A.; Sep. 2001; 20p; In English
Report No.(s): AD-A396605; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Environmental Medicine Genome Bank (EMGB) project is an ongoing effort to identify and characterize genes relevant to environmental illnesses and to human physical performance. to accomplish this, the EMGB banks DNA samples from human volunteers who have participated in environmental and human performance studies or material obtained under approved Brigham and Women's Hospital protocols that would otherwise have been discarded. The EMGB maintains a registry of this phenotypic information. The EMGB can be used to identify polymorphisms in genes that are potentially of interest to environmental medicine and to obtain an estimate of the frequency of these polymorphisms in young, healthy U.S. adults because of the ethnically diverse and geographically dispersed backgrounds of the donors. Additionally, this resource also serves as a valuable source of control material for genetic studies of human diseases, such as asthma. The project is performed as part of a cooperative research and development agreement (CRDA) with the Division of Pulmonary and Critical Care Medicine at Brigham and Women's Hospital. B-lymphocytes immortalized using the Epstein Barr Virus (EBV) have been added to the EMGB in attempts to maintain stocks of genetic material that are phenotypically characterized. These samples include cells and DNA from asthmatics as well as characterized non-asthmatics. This report provides updated information about the samples currently stored in the EMGB. It is intended as a reference document for researchers who wish to make use of this resource, and fulfills the annual reporting requirement of CRDA number DAMD 17-00-0017.
DTIC
*Genes; Libraries; Diseases; Physical Fitness*

**20020016125** Utah Univ., Salt Lake City, UT USA
**Randomized Trial of Interleukin-2 (IL-2) as Early Consolidation Following Marrow Ablative Therapy with Stem Cell Rescue for Metastatic Breast Cancer** ***Annual Report, 1 Oct. 2000-30 Sep. 2001***
Samlowski, Wolfram E.; Oct. 2001; 13p; In English
Contract(s)/Grant(s): DAMD17-99-1-9417
Report No.(s): AD-A396717; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Marrow ablative doses of chemotherapy followed by stem cell rescue (MAT/SR) produce a high frequency of objective responses in patients with metastatic breast cancer, with up to 40-50% complete responses. Unfortunately, responses tend to be short-lived. Interleukin-2 (IL-2) can activate lymphocytes to kill multi-drug resistant cancer cells. Our phase I data established that a single course of low-dose IL-2 (1.6 million IU/m2/day as a continuous IV infusion for 18 days) as consolidation treatment to patients with metastatic breast cancer early after MAT/SR. Seven patients (60%) remain in complete remission at a median of 435 days (range: 224 - 720 days) post stem cell transplantation. Since this trial was designed, substantial changes have taken place in breast cancer treatment.
DTIC
*Bone Marrow; Ablation; Mammary Glands; Cancer; Chemotherapy*

**20020016128** Thomas Jefferson Univ., Philadelphia, PA USA
**Estimation of Tumor Angiogenesis with Contrast Enhanced Subharmonic Ultrasound Imaging** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Forsberg, Flemming; Jul. 2001; 10p; In English
Contract(s)/Grant(s): DAMD17-00-1-0464
Report No.(s): AD-A396704; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Preliminary reports indicate that ultrasound contrast significantly improves the sensitivity and specificity of breast ultrasound imaging. New contrast-specific imaging modalities such as harmonic imaging (HI) may further improve the accuracy of breast ultrasound. Unfortunately, HI suffers from reduced blood-to-tissue contrast resulting from second harmonic generation and accumulation in tissue. As an alternative we propose using subharmonic imaging (SHI) by transmitting at the double the resonance frequency (2f0) and receiving at the subharmonic (f0). Because of no subharmonic generation in tissue and significant subharmonic scattering from some new contrast agents SHI has the potential to detect slow, small volume blood flow associated with tumor neovascularity, making early detection and identification of tumors very likely. Hence, the current project proposes to increase the ability of breast ultrasound to differentiate between benign and malignant lesions by combining injection of an ultrasound contrast agent with SHI. to date, a dual-transducer pulse-echo system has been built to perform in vitro SHI measurements and initial experiments have been conducted with the contrast agents Levovist and Optison. Up to 20 dB subharmonic signal components were measured. A phantom for measuring perfusion rates is currently being designed.
DTIC
*Blood Flow; Imaging Techniques; Ultrasonics; Acoustic Imaging*

**20020016160** Burnham Inst., La Jolla, CA USA
**Role of Nip3 in Apoptosis and Chemoresponses of Breast Cancer Cells** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Guo, Bin; Jul. 2001; 18p; In English
Contract(s)/Grant(s): DAMD17-00-1-0172
Report No.(s): AD-A396718; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The overall objective of this project is to investigate the molecular mechanisms of Nip3's function in apoptosis and the role of Nip3 in chemoresponses of breast cancer cells. The first aim is to determine whether Nip3 acts directly or indirectly to induce cell death. The results showed that Nip3 does not directly induce cell death in yeast. Next, the role of Bax in Nip3 action was evaluated in the induction of yeast cell death. When Bax and Nip3 were co-transfected into yeast cells, no synergy between Bax and Nip3 in cell death induction was observed. Co-immunoprecipitation experiments also showed that there is no direct interaction between Bax and Nip3. Thus Nip3 induces apoptosis independent on Bax but requires additional factors. The potential Nip3 interacting proteins that collaborate with Nip3 to induce cell death in yeast is currently being investigated by yeast two-hybrid cloning. A parallel study of other BH3 domain containing protein has resulted the cloning of a new member of the Bcl-2 family, Bcl-GL. Over-expression of Bcl-G or Bcl-05 in cells induced apoptosis, but Bcl-Gs was far more potent than Bcl-O. Apoptosis induction by Bcl-Cl5 depended on the BH3 domain, and was suppressed by co-expression of anti-apoptotic Bcl-X protein. Bcl-O gene is located in chromosome 12pl2, a region frequently subjected to loss of heterozygosity in cancer patients. The role of Bcl-O in breast cancer development and chemoresponse will be further studied.
DTIC
*Apoptosis; Mammary Glands; Cancer*

**20020016246** Cleveland Clinic Foundation, Cleveland, OH USA
**Tissue Engineering Initiative** ***Annual Report, 1 Aug. 2000-31 Jul. 2001***
Hascall, Vincent; Aug. 2001; 122p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-99-1-9475
Report No.(s): AD-A396758; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Cleveland Clinic Foundation Tissue Engineering Initiative was proposed to initiate novel tissue engineering projects as a collaboration between connective tissue biochemists, bioengineers, prototype engineers, and physician researchers from the Department of Biomedical Engineering. The primary focus of these projects was to test applications of hylan gels (divinyl sulfone crosslinked, purified hyaluronan). Gels were obtained from the Matrix Biology Institute (formerly BioMatrix, Inc.), in addition to in-house gel fabrication. During the second year of this project, considerable effort was devoted to developing the technology to repeatably produce hylans with improved mechanical strength. The second major focus was to investigate ways to improve cell attachment and proliferation on and within the gels.

DTIC

*Tissue Engineering; Cells (Biology); Bioengineering; Connective Tissue*

**20020016263** Pennsylvania Univ., Medical Image Processing Group, Philadelphia, PA USA
**Identification of Genetic Modifiers of Breast Cancer Risk** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Weber, Barbara L.; Nathanson, Katherine; Jul. 2001; 9p; In English
Contract(s)/Grant(s): DAMD17-00-1-0405
Report No.(s): AD-A396698; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The purpose of this study is to identify genetic modifiers of cancer risk in women with BRCA1 and BRCA2 mutations. We are using two complementary strategies: (1) association studies in candidate genes from the immune surveillance and DNA damage response pathways; and (2) a genome-wide scan using relative pairs with BRCA1 mutations to identify novel regions containing modifier genes. to date we have assembled a case-control sample set of 448 mutation carriers and a relative pairs set of 534 mutation carriers. We have completed a sequencing survey of a panel of immune surveillance genes and determined the population frequency of the variants we identified. We have examined a number of candidate genes and have data suggesting variants in TNF-alpha, IL-6, XPD, and p53 may have a role in altering cancer risk in these high risk women. This work is important not only in leading to more refined cancer risk estimates for women with BRCA1 and BRCA2 mutations, but also will yield candidates for risk alleles in the general population and generate hypotheses for mechanisms that explain these effects. Once these mechanisms have been elucidated, these points in key pathways become excellent targets for preventative and therapeutic intervention.

DTIC

*Cancer; Genes; Genetics; Mammary Glands; Mutations*

**20020016264** Sloan-Kettering Inst. for Cancer Research, New York, NY USA
**Radiolabeled Herceptin to Increase Treatment Efficacy in Breast Cancer Patients with Low Tumor HER-2/neu Expression** ***Annual Report, 15 Jun. 2000-14 Jun 2001***
Sgouros, George; Jul. 2001; 32p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-00-1-0429
Report No.(s): AD-A396696; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary objective of the proposal is to evaluate the efficacy and feasibility of using radiolabeled Herceptin antibody to target rapidly accessible breast carcinoma cells or micrometastases. by using Herceptin to specifically deliver radiation we anticipate that the efficacy of Herceptin will be extended to include breast cancer cells that are not high HER-2/neu antigen expressors. This hypothesis will be tested using the spheroid model to simulate rapidly accessible micrometastases. An alpha-particle emitting radionuclide will be used to enhance tumor cell kill. Spheroids of three breast carcinoma cell lines exhibiting high, intermediate, and low expression of HER-2/neu have been generated and characterized. Antibody penetration by confocal microscopy has been measured for these three spheroids and an appropriate Herceptin concentration has been chosen for cell kill experiments. Preliminary cell kill experiments using Herceptin labeled with an alpha-particle emitter have been carried out; dose-response studies have been started and are on going. Preliminary results suggest that alpha-emitter labeled Herceptin will be effective against tumor cells that have a three to four-fold lower expression of HER/neu.

DTIC

*Antibodies; Cancer; Cells (Biology); Mammary Glands*

**20020016265** Georgetown Univ., Medical Center, Washington, DC USA

**Characterization of Early Genomic Changes in Mammary Glands of High Risk Women** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***

Dickson, Robert B.; Jul. 2001; 15p; In English

Contract(s)/Grant(s): DAMD17-99-1-9193

Report No.(s): AD-A396666; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Because many of the familial breast cancer patients carry a mutation in BRCAl on chromosome l7 or BRCA2 on chromosome 13, the first genetic event that may occur in their mammary glands to begin the progression toward cancer may be loss of heterozygosity (LOH) on one of these two chromosomes. It is unknown if these genetic changes correspond to a recognizable histopathological abnormality, nor what are the precise associated chromosomal changes leading to cancer. We hypothesize that such genomic changes may precede morphologic changes and thus we may detect evidence for such changes (eg LOH) in morphologically normal breast tissues or benign lesions surrounding breast tumors in BRCA1/2 positive patients. We have recently developed a panel of markers to study LOH in morphologically well characterized and carefully laser capture microdissected, breast tissues. We are evaluating a group of BRCA1/2 positive patients with breast cancer who are followed up by our Cancer Genetics Program at the Lombardi Cancer Center. Our studies so far support our hypothesis. Specifically, several of the markers studied show evidence of LOH in histologically normal looking tissues and in benign lesions surrounding breast cancer in both BRCAl and 2 positive patients.

DTIC

*Genetics; Genome; Mammary Glands; Females; Human Pathology*

**20020016266** Texas Univ., M D Anderson Cancer Center, Houston, TX USA

**BRCA2 and Genome Integrity** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***

Su, Li-Kuo; Jul. 2001; 10p; In English

Contract(s)/Grant(s): DAMD17-00-1-0317

Report No.(s): AD-A396665; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The BRCA2 tumor suppressor gene has been suggested to play an important role in DNA repair and maintaining genome integrity. Most evidences supporting this hypothesis, however, were obtained from studying mouse embryonic stem cells or embryonic fibroblast. The importance of BRCA2 in maintaining genome integrity in human cells is not very clear. We have completed the Task 1, generation of Capan-1 derivatives that conditionally express wild type BRCA2. Capan-1 is the only human cell lines known to not express wild type BRCA2. We have obtained two Capan-1 derivatives that express exogenous wild type BRCA2 under the regulation of tetracycline. We have also obtained several Capan-1 derivatives that express exogenous mutant BRCA2, either constitutively or regulated by tetracycline. We have also carried out the first part of the Task 3, characterization of Capan-1 derivatives to genotoxic agents. We examined the sensitivity of wild type BRCA2-expressing Capan-1 derivatives to ionizing radiation and DNA damaging chemicals. Our preliminary results showed that there was no detectable difference in the sensitivity to these treatments between when these cells expressed or did not express the wild type BRCA2.

DTIC

*Genome; Gene Expression; Tumors; Cells (Biology); Mammary Glands*

**20020016267** Rhode Island Hospital, Providence, RI USA

**Evaluation of GPR30, a Novel Estrogen Receptor, for Assessing Responsiveness to Anti-Estrogen Therapy** ***Annual Report, 1 Jun. 2000-30 May 2001***

Filardo, Edward J.; Jun. 2001; 95p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0419

Report No.(s): AD-A396664; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Antiestrogens are the most effective and widely administered therapy for the management of breast cancer. Their efficacy has been attributed to their ability to antagonize the estrogen receptor, and the presence of ER in breast tumor biopsy specimens correlates well with responsiveness to antiestrogen therapy. Still, one in four patients with ER-positive tumors do not respond to antiestrogens, while one in six patients with ER-negative breast tumors undergo objective tumor regression following antiestrogen therapy (Witliff, 1984). These clinical observations suggest that alternative mechanisms of estrogen action may regulate the growth and survival of breast tumors. We have provided evidence that estrogen acts independently of the known estrogen receptors, ERalpha and ERbeta, via the G-protein coupled receptor, GPR30, to regulate the EGFR-to-MAP K signaling axis (Filardo et al, 2000; reviewed in Filardo, 2001; Filardo et al, 2001). Moreover, we have shown that the antiestrogens, tamoxifen and faslodex (ICI 182, 780), also trigger GPR30-dependent regulation of this HB-EGF autocrine loop. Dysregulation of the EGFR-to-MAP K signaling axis is a common occurrence in breast cancer (Slamon et al, 1989, Sivaraman et al, 1997). The subject

of this DoD award is to investigate the relationship between GPR30 expression and MAP K activity in breast tumor biopsy specimens obtained at first diagnosis or following antiestrogen or other adjuvant therapies. The results of these studies may lead to a further refinement in assessing responsiveness to antiestrogen therapy.
DTIC
*Estrogens; Mammary Glands; Receptors (Physiology); Chemotherapy; Cancer; Proteins*

**20020016268** Evanston Northwestern Healthcare Research Inst., Evanston, IL USA
**Caspase Deficiency: Involvement in Breast Carcinogenesis and Resistance** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Yang, XiaoHe; Jul. 2001; 71p; In English
Contract(s)/Grant(s): DAMD17-99-1-9180
Report No.(s): AD-A396661; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Apoptosis (programmed cell death) is a fundamental process involved in homeostasis and the biological response to anti-tumor therapy. Aberrant expression of apoptotic regulators, such as Bax-a, Bcl-2 and p53 has been associated with breast cancer carcinogenesis and therapeutic resistance. Apoptosis is mediated by caspases, groups of proteases. We and others have shown that caspase 3, an effector caspase, is deficient in MCF-7 breast cancer cell line. This project was designed to study the incidence and significance of caspase deficiency in breast cancers.
DTIC
*Apoptosis; Carcinogens; Mammary Glands; Physiological Responses; Homeostasis*

**20020016474** Utah State Univ., Logan, UT USA
**Development of Laulimalide-Based Microtubule-Stabilzing Agents: New Chemistry for the Treatment of Breast Cancer** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Davidson, Bradley S.; Jul. 2001; 7p; In English
Contract(s)/Grant(s): DAMD17-00-1-0480
Report No.(s): AD-A396707; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Through a collaborative research program involving Utah State University and the Cancer Research Center of Hawaii, we have discovered that the sponge-derived macrolides laulimalide and isolaulimalide are potent cytotoxins with paclitaxel-like antimicrotubule-stabilizing activity. Laulimalide is a potent inhibitor of cellular proliferation with an IC50 in the low nanomolar range and it maintains activity against a drug resistant, P-glycoprotein over-expressing ovarian cancer cell line. Laulimalide represents a lead compound for new class of microtubule-stabilizing agents with activities that may prove therapeutically useful for the treatment of breast cancer. The aim of this project is to utilize a combinatorial solid-phase synthetic approach for the construction of a library of laulimalide analogs for structure activity relationship (SAR) studies. In an effort to discover a new chemotherapeutic agent for the treatment of breast cancer we propose to do the following: (1) transfer our current solution-phase synthetic approach to solid phase; (2) using a split and pool strategy, prepare 260 laulimalide analogs; (3) test laulimalide analogs for microtubule-stabilizing activity, cytotoxicity against both drug-sensitive and drug-resistant breast cell lines; and (4) submit active analogs to the NCI for screening in the 60-cell line. Work to date has been concentrated on the adaptation of our solution phase laulimalide synthetic methods for efficient conversion to the solid phase. A new approach to the syntheses of fragments A and B and their subsequent coupling has been developed and progress has been made toward the preparation of a series of fragment B analogs as well as of the synthesis of fragment C3. We have also elected to push back the point within the synthesis at which fragment A will be attached to the solid phase resin.
DTIC
*Cancer; Drugs; Inhibitors; Mammary Glands; Solid Phases*

**20020016475** Yale Univ., New Haven, CT USA
**Tumor Specific Gene Expression and Tumor Specific Vector Replication for Systemic Chemotherapy Sensitization Treatment of Breast Cancer** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Deisseroth, Albert B.; Jul. 2001; 66p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-99-1-9457
Report No.(s): AD-A396709; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
We have developed a safety modified adenoviral vector in which the tumor specific L-plastin promoter can be used to control the expression of therapeutic genes such as cytosine deaminase (CD). The CD gene product catalyzes the conversion of a non-toxic precursor, 5-Fluorocytosine (5FC) into a drug, 5-Fluorouracil (5FU), thereby sensitizing the cells in which it is produced to SFC induced toxicity. We have also generated vectors in which the L-plastin promoter is used to drive the expression of the viral ElA gene, which the adenovirus needs to replicate within mammalian cells. The replication of a virus within a mammalian cell takes

over all of the metabolic and cell proliferative machinery of the cells and thereby kills it. Our data shows that the adenoviral vector which carries the L-plastin-ElA transcription unit can replicate within breast cancer cells and other estrogen dependent carcinomas, such as ovarian cancer, while not being able to replicate in normal cells. This L-plastin-ElA vector can suppress the growth of human breast cancer cell lines in immunosuppressed mice. We have recently isolated a vector in which both the CD ElA genes are under the control of the L-plastin promoter, which is currently under study.
DTIC
*Cancer; Chemotherapy; Gene Expression; Mammary Glands; Tumors; Estrogens*

**20020016476** Pennsylvania Univ., Medical Image Processing Group, Philadelphia, PA USA
**Parallel, Rapid Diffuse Optical Tomography of Breast** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Yodh, Arjun G.; Jul. 2001; 11p; In English
Contract(s)/Grant(s): DAMD17-00-1-0408
Report No.(s): AD-A396711; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During the last year we have experimentally and computationally investigated rapid acquisition and analysis of informationally dense diffuse optical data sets in the parallel plate compressed breast geometry. We have developed and tested a three-dimensional image reconstruction algorithm for the diffusive wave inverse problem that runs on a parallel computer cluster. This code uses a finite difference method in the forward calculation, a novel Integro-Differential equation, previously developed by this group, in the reconstruction. There has been a significant improvement in our instrumentation and measurement capabilities. A hybrid RF/CW diffuse optical tomography (DOT) system measures limited number of frequency-domain reemission data and significantly larger continuous wave transmission data by a lens coupled CCD simultaneously. The wavelength of the light source is optically switched from 690, 750, 786, and 830 nm and then its position is switched among 45 different positions on the compression plate. The instrument and reconstruction algorithm performance have been tested using small silicone tissue phantoms as a tumor of various size and optical properties suspended into the liquid tissue phantom. The study of the effect of boundary between the matching fluid and breast has been initiated by building and taking measurements from tissue phantoms with breast shape, embedded with small objects with higher absorption or scattering.
DTIC
*Algorithms; Image Reconstruction; Mammary Glands; Tomography; Tumors*

**20020017034** NASA Ames Research Center, Moffett Field, CA USA
**Calf Venous Compliance in Supine Posture Equals that Measured with Head-up Tilt**
Watenpaugh, Donald E., NASA Ames Research Center, USA; Ballard, R. E., NASA Ames Research Center, USA; Breit, G. A., NASA Ames Research Center, USA; Bernauer, E. M., California Univ., USA; Blomqvist, C. G., Texas Univ., USA; Hargens, Alan R., NASA Ames Research Center, USA; [1995]; 1p; In English; 16th Annual Gravitational Physiology Meeting, 19-24 Mar. 1995, Reno, NV, USA
Contract(s)/Grant(s): RTOP 199-14-12-04; No Copyright; Avail: Issuing Activity; Abstract Only

Calf venous compliance is measured conventionally with venous occlusion, where compliance equals calf volume elevation per mmHg thigh occlusion pressure in relaxed legs of supine subjects. Compliance may also be measured during stepwise head-up tilt (HUT) as calf volume elevation per mmHg gravitational venous pressure elevation produced by HUT. Although HUT on a tilt table with a footplate activates calf muscles which could reduce compliance, this muscle activation is relatively small (less than or = 10% of maximal voluntary levels). Therefore, we hypothesized that calf compliance measured with HUT equals that measured with conventional supine venous occlusion. The venous occlusion protocol consisted of 20, 40, 60 and 80 mmHg thigh cuff inflations held for 1, 2, 3 and 4 min, respectively, in 14 supine subjects. One min of cuff deflation to 0 mmHg separated occlusions. Nine other subjects underwent HUT through the following angles held for 30s each: -12 deg., -6 deg., 0 deg., 12 deg., 30 deg., 54 deg., and 90 deg. HUT calf venous pressure data were interpolated from Katkov and Chestukhin; these data correspond to 70-80% of calculated calf venous pressure changes (pgh). Liquid metal-in-silastic strain gauges measured calf volume for both venous occlusion and HUT compliance. Relaxed calf compliance in supine subjects equaled 4.6 +/- 0.4 ml/mmHg (X +/- SE), as measured with venous occlusion. Calf compliance during HUT equaled 4.6 +/- 1.0 ml/mmHg. Therefore, calf compliance in supine, relaxed subjects equals that measured during head-up tilt. We conclude that the minimal calf muscle activation which occurs during HUT does not importantly affect calf compliance.
Author
*Activation (Biology); Attitude (Inclination); Blood Pressure; Liquid Metals; Muscular Function; Thigh*

**20020017035** NASA Ames Research Center, Moffett Field, CA USA

**Body Weight Gain during Altered Gravity: Spaceflight, Centrifugation and Transitions**

Wade, Charles E., NASA Ames Research Center, USA; Harper, J. S., NASA Ames Research Center, USA; Daunton, N. G., NASA Ames Research Center, USA; Corcoran, M. L., NASA Ames Research Center, USA; Morey-Holton, E., NASA Ames Research Center, USA; [1995]; 1p; In English; 16th Annual Gravitational Physiology Meeting, 19-24 Mar. 1995, Reno, NV, USA

Contract(s)/Grant(s): RTOP 199-16-12-01; No Copyright; Avail: Issuing Activity; Abstract Only

Gravity is a force that influences all living systems, and is often disregarded in the study of environment on growth and development. to assess the effect of gravity exposure on growth, immature rats (130-200 g) were evaluated during chronic altered gravity exposure and during transition between gravity fields. The effects of 14 days of spaceflight on body weight gain were evaluated (n=12) and compared to controls. Spaceflight did not affect weight gain. In 6 rats, the transition from spaceflight to 1 G showed a significant (p less than 0.05) post flight weight loss over 48 hr of 13 g compared to controls. Over subsequent days this loss was compensated for with no difference noted after 5 days. Exposure to hypergravity, 2 G for 16 days, was evaluated in groups of n=6 (Control; On Center Control (OCC); Centrifuged). With centrifugation or OCC there was a reduction in body weight within 24 hr. The OCC regained control weights within 13 days. The weight difference, 26 +/- 1 g, persisted with 2 G with no subsequent difference in weight gain over days 3-16 compared to controls; 3.7 +/- 0.1 versus 3.9 +/- 0.1 g/day respectively. Transition from centrifugation to 1 G resulted in a weight increase within 48 hours. Over 16 days the rate of gain was increased 3.1 +/- 0.1 g/day for centrifuge compared to 2.1 +/- 0.1 g/day for controls between Day 3 to 16. However, differences from control were still noted on Day 16. Transition from one gravity field to another causes acute changes in body weight. Transition to microgravity or 1 G, following the acute changes, results in adjustments to attain a normal weight. In hypergravity the acute reduction in body weight persist, but weight gain is normal. Transitioning from hypergravity to 1G results in an increased weight gain to compensate for the persistent reduction during exposure.
Author

*Microgravity; Losses; Gravitational Effects; Centrifuging; Body Weight*

**20020017455** NASA Ames Research Center, Moffett Field, CA USA

**Measurement of Transcranial Distance During Head-Down Tilt Using Ultrasound**

Torikoshi, Shigeyo, NASA Ames Research Center, USA; Ballard, R. E., NASA Ames Research Center, USA; Watenpaugh, D. E., NASA Ames Research Center, USA; Murthy, G., NASA Ames Research Center, USA; Bowley, S., NASA Ames Research Center, USA; Yost, W. T., NASA Langley Research Center, USA; Hargens, Alan R., NASA Ames Research Center, USA; [1995]; 1p; In English; 16th Annual Gravitational Physiology Meeting, 19-24 Mar. 1995, Reno, NV, USA

Contract(s)/Grant(s): RTOP 199-14-12-04; No Copyright; Avail: Issuing Activity; Abstract Only

Exposure to microgravity probably elevates blood pressure and flow in the head which may increase intracranial volume (ICV) and pressure (ICP). Due to the slightly compliant nature of the cranium, any increase of ICP will increase ICV and transcranial distance. We used a noninvasive ultrasound technique to measure transcranial distance (frontal to occipital) during head-down tilt. Seven subjects (ages 26-53) underwent the following tilt angles: 90 deg. upright, 30 deg., 0 deg., -6 deg., -10 deg., -6 deg., 0 deg., 30 deg., and 90 deg. Each angle was maintained for 1 min. Ultrasound wave frequency was collected continuously and transcranial distance was calculated (Delta(x) = x(Delta)f/f, where x is path length and f is frequency of the wave) for each tilt angle. Frequency decreased from 503.687 kHz (90 deg. upright) to 502.619 kHz (-10 deg.). These frequencies translated to an increased transcranial distance of 0.403 mm. Although our data suggest a significant increase in transcranial distance during head-down tilt, this apparent increase may result, in part, from head-down tilt-induced subcutaneous edema or cutaneous blood volume elevation. In three subjects, when the above protocol was repeated with an ace bandage wrapped around the head to minimize such edema, the increased transcranial distance from 90 deg. to -10 deg. was reduced by 0.174 mm. Further development of the technique to quantify bone-to-bone expansion unconfounded by cutaneous fluid is necessary. Therefore, this ultrasound technique may provide measurements of changes in cranial dimensions during microgravity.
Author

*Microgravity; Blood Pressure; Blood Volume; Physiological Responses; Attitude (Inclination)*

**20020017458** Medicine and Dentistry Univ. of New Jersey, Piscataway, NJ USA

**Genetic Susceptibility to Cancer Chemotherapy in Human Breast Cancer** ***Annual Report, 1 Jul. 1999-30 Jun. 2000***

Hait, William; Jul. 2000; 12p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-98-1-8043
Report No.(s): AD-A396823; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We have focused on the ability to predict responsiveness to tubulin targeting chemotherapeutic drugs by understanding the role of p53 repression on the expression of proteins that regulate microtubule dynamics. We previously demonstrated that

repression of microtubule associated protein 4 (MAP-4) produced tubulin depolymerization sensitivity to vinca alkaloids, and resistance to taxanes. We built on this observation to design a phase I clinical trial to determine if this could be accomplished in and confirmed fl%the ability to produce this effect in several human specimens. At the same time we studied the repression of stathmin, a cytosolic phosphoprotein which binds to and stabilizes tubulin heterodimers. Stathmin appears to be more sensitive to repression by p53 than MAP-4 and may lead to additional approaches to treatment of patients with breast cancer during the next grant period.
DTIC
*Genetics; Chemotherapy; Mammary Glands; Cancer*

**20020017460** Rochester Univ., NY USA
**Rolling Circle Transcription of Ribozymes Targeted to ras and mdr-1** ***Annual Report, 1 Sep. 1999-31 Aug. 2000***
Kool, Eric T.; Sep. 2000; 42p; In English
Contract(s)/Grant(s): DAMD17-98-1-8239
Report No.(s): AD-A396819; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We report new progress on the use of the rolling circle transcription strategy for production of ribozymes in vitro and in living cells. Optimized circular DNA vectors have been selected from randomized libraries and the selected sequences were found to be transcribed significantly more strongly than the library as a whole by two different RNA polymerases. Optimized rolling circle vectors were then constructed to encode a ribozyme targeted to a drug resistance gene in a bacterium. The vector was then shown to lower the activity of this gene in the living bacterial cells. A similar strategy may one day be useful for inhibiting genes (such as breast cancer-associated genes) in human cells.
DTIC
*Ribonucleic Acids; In Vitro Methods and Tests; Cancer; Mammary Glands; Genes*

**20020017967** California Univ., Dept. of Radiology, San Francisco, CA USA
**Sub-regional Assessment of Bone Loss in the Axial Skeleton in Long-Term Spaceflight** ***Monthly Report, 1-31 Dec. 2001***
Lang, Thomas F., California Univ., USA; Nov. 30, 2001; 2p; In English
Contract(s)/Grant(s): NAS9-99055
Report No.(s): NAS-9-99055-36; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
All three members of the Increment Three crew were scanned on the 27th and 28th of December, 2001. The data were of excellent quality and now we have a total of five crew members with baseline and return visits. We have analyzed these images and are ready to send results to the crew members.
Author
*Bone Demineralization; Spacecrews; Musculoskeletal System*

**20020018028** Columbia Univ., New York, NY USA
**P53, Environmental Risk Factors and Breast Cancer: A Population Based Study** ***Annual Report, 1 Sep. 1999-31 Aug. 2000***
Gammon, Marilie D.; Sep. 2000; 8p; In English
Contract(s)/Grant(s): DAMD17-98-1-8052
Report No.(s): AD-A396818; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
The presence of p53 mutations in tumor tissue have been hypothesized to represent a 'fingerprint' of environmental carcinogens. As a first step in testing this hypothesis in breast cancer in humans, we are evaluating whether risk for women with tumors that show p53 protein overexpression (1)53+) assessed by immunohistochemistry in relation to certain environmental exposures, such as hormone replacement therapy, alcohol use, cigarette smoking, DDT levels in blood, or polycyclic aromatic hydrocarbons (PAH-DNA adducts), is higher than risk among women with tumors that show no p53 protein overexpression (1)53-), as compared with population-based controls. For this molecular epidemiology project, archived tumor tissue is being retrieved for the case participants of the NIH-funded parent study, the Long Island Breast Cancer Study Project. The retrieved archived tumor tissue is being cut and prepared to establish a tumor bank that can be linked to already collected risk factor data and stored samples of blood and urine. Two prepared slides per subject are being utilized for the p53 immunohistochemical assays. The lab data from the molecular epidemiology component will be coupled with the risk factor data on the respondents of the parent study to perform statistical analyses to evaluate the hypothesis of the molecular epidemiology component.
DTIC
*Cancer; Carcinogens; Epidemiology; Mutations; Risk; Tumors; Exposure*

**20020018029** Baylor Coll. of Medicine, Houston, TX USA

**Alternative DNA Damage Checkpoint Pathways in Eukaryotes** ***Annual Report, 23 Mar. 2000-22 Mar 2001***

Scott, Kenneth L.; Plon, Sharon E.; Apr. 2001; 12p; In English

Contract(s)/Grant(s): DAMD17-98-1-8023

Report No.(s): AD-A396817; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The human CHES1 (checkpoint suppressor 1) gene is sufficient to restore DNA damage-induced G2 arrest in multiple S. cerevisiae checkpoint mutants by activation of an alterative checkpoint pathway. Our goal is to identify the CHB (checkpoint bypass pathway) genes that constitute this alterative checkpoint, to isolate the human counterparts of these genes, and to compare their structure and activity in normal and cancer tissues. In an effort to identify the genes involved in the alternative pathway, we performed a comprehensive screen in S. cerevisiae by mutagenizing a cdc9-8, rad9delta mutant strain, which is both ultraviolet (UV)-resistant and grows at 30 C in the presence of CHES1. The screen resulted in three mutants that display varying degrees of temperature- and UV-sensitivity. In summary, chb13 is a strong mutant in which CHES1 can no longer suppress either the temperature or UV-sensitive phenotypes chb16 and chb57 are highly temperature-sensitive/moderately UV-sensitive and highly UV-sensitive/moderately temperature-sensitive, respectively. Despite multiple attempts, we were unable to identify the gene(s) mutated in the chb13 mutant strains. We have taken an alterative approach to this goal by using an S. cerevisiae insertional mutagenesis method, which will avoid the cloning problems experienced in using the previous EMS methodology. In addition, in efforts to identify CHES1 1-interacting proteins by biochemical methods, we have constructed a human SOS (son of sevenless)-CHESl bait construct and a GST (Glutathione-S-Transferase)-CHES1 fusion construct for use in a cytoplasmic yeast-two-hybrid screen and GST pulldown experiments, respectively. The insertional mutagenesis screen, the two-hybrid screen, and the pulldown experiments are currently in progress.

DTIC

*Damage; Deoxyribonucleic Acid; Eukaryotes; Mutations; Genetic Engineering*

**20020018030** Walter Reed Army Medical Center, Washington, DC USA

**Organizational TeleCardiology**

Vernalis, Marina; May 2000; 3p; In English

Contract(s)/Grant(s): MIPR-OEC5DT0078

Report No.(s): AD-A396812; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have successfully implemented several phases of deployment model: (1) Setup, installation, and placement on each LAN of two NT servers with MS Exchange 5.5 and preparation and setup of the viewing and capture stations; (2) Installation and testing of the mission-critical application Med-Vizer on the exchange platforms, which have included two NT exchange servers, three NT viewing stations, and one Windows 98 capture station; and (3) Test transfer of the internal LANs to simulate SMTP processes through each LAN's exchange server. Program contents updates have occurred three times: (1) Re-writing of programming code to meet security criteria of Army-wide mandate proposing all e-mail transfers to be conducted via SMTP instead of POP3; (2) Update of complete content information of Med-Vizer program due to incorrect spelling terminology of specific medical terms; and (3) Planned update of the patient medical record form in the Med-Vizer program.

DTIC

*Local Area Networks; Performance Tests; Computer Programs; Cardiology*

**20020018031** Alabama Univ., Birmingham, AL USA

**Biodegradable Vaccine Microspheres for System and Mucosal Immunization Against Equine Encephalitis** ***Final Report, Phase II. 31 Mar. 1998-31 Aug. 2001***

Michalek, Suzanne M.; Sep. 2001; 30p; In English

Contract(s)/Grant(s): DAMD17-97-C-7002

Report No.(s): AD-A396811; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the increased mobility of society and the threat of agents being used in biological warfare, the spread of diseases such as Equine Encephalitis (EE) is of major health significance and thus the need for effective vaccines becomes even more critical. The vaccines for Eastern, Western and Venezuelan EE are currently used under IND status to immunize at-risk lab personnel, since they have several limitations. Recent interest has been directed towards developing stable, single-dose vaccines that can be given via mucosal or systemic routes and induce protective immune responses against infectious agents, e.g., EEE, WEE and VEE. The goals of the studies proposed in this contract were as follows; (1) Determine the effectiveness of VEE pulse release microspheres in inducing protection from aerosol and systemic challenge; (2) Determine the immunogenicity of EEE and WEE pulse release microspheres and their effectiveness in inducing protective responses; (3) Evaluate immune interference, cross reactivity and cross protection between EE viruses; (4) Determine if intranasal immunization of our VEE vaccine is effective in inducing

protective responses; and (5) Determine the effect of adjuvants in augmenting protective responses. Significant progress was made on all but the last goal. Evidence is provided on the ability of VEE microspheres to induce protective response, on the immunogenicity of the EEE and WEE vaccines and on aspects of cross reactivity and immune interference.
DTIC
*Encephalitis; Immunology; Microparticles; Vaccines; Viruses*

**20020018043** Children's Hospital of Los Angeles, Los Angeles, CA USA
**Identification of Oncogenes Cooperating in Murine Mammary Tumorigenesis** ***Annual Report, 1 Jun. 2000-31 May 2001***
Lopez-Diego, Rocio S.; Shackleford, Gregory M.; Jun. 2001; 12p; In English
Contract(s)/Grant(s): DAMD17-00-1-0199
Report No.(s): AD-A396713; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In order to identify and characterize additional novel or unexpected proto-oncogenes that, in addition to fibroblast growth factors (Fgfs) cooperate with Wnt1 in murine mammary tumorigenesis, we have generated MMTV-infected Wnt1/0b/ DN-Fgfr2 bitransgenic mice. While the Wnt oncogenic signal is constitutively overexpressed in their mammary gland, cooperative oncogenic Fgf signals should be abolished by the expression of a dominant-negative FGF receptor (DN-Fgfr2). Only those cells carrying MMTV-insertionally activated cellular proto-oncogenes, other than Wnts and Fgfs, should have a growth advantage in the bitransgenic mammary gland. The clonal expansion of these cells leads to mammary tumorigenesis. As proposed, we have generated a cohort of 25 MMTV-infected Wnt10b/DN-Fgfr2 bitransgenic females. As controls, we have also generated an uninfected bitransgenic cohort, as well as MMTV-infected/uninfected Wnt0b and DN-Fgfr2 female groups. to date, several mammary adenocarcinomas have appeared in the MMTV infected bitransgenic animals.
DTIC
*Carcinogens; Fibroblasts; Mammary Glands; Cancer*

**20020018524** Purdue Univ., West Lafayette, IN USA
**Functional Analysis of the ErbB4 Receptor Tyrosine Kinase** ***Annual Report, 1 Jul. 2000-30 Jun. 2001***
Riese, David J.; Jul. 2001; 156p; In English; Original contains color images
Contract(s)/Grant(s): DAMD17-00-1-0415
Report No.(s): AD-A396708; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This career development award is supporting a multi-faceted, multidisciplinary approach to elucidate the roles of EGF (epidermal growth factor) family hormones and ErbB receptors in breast cancer and to develop novel strategies to target these hormones and receptors. We have four major efforts underway: (1) We have been assaying novel quinazolines and analogs of lavendustin A for inhibition of EGFR tyrosine kinase activity. The goal is to identify potential breast tumor imaging agents and breast tumor chemotherapeutics that target the EGFR; (2) We have constructed a constitutively active mutant of the ErbB4 receptor tyrosine kinase. The activities of this mutant suggest that ErbB4 may be coupled to mammary tumor cell growth arrest and mammary tumor suppression; (3) We have identified the ErbB family receptors that are activated by four novel EGF family hormones. This is the first step in determining the role that these hormones may play in mammary tumorigenesis; and (4) We have identified amino acid residues in the EGF family hormone Neuregulin 2beta that are critical for activation of ErbB4 signaling by this hormone. This is the first step in developing potential breast cancer therapeutics that specifically target ErbB4.
DTIC
*Cancer; Hormones; Mammary Glands; Tumors; Functional Analysis*

**20020018860** National Defence Research Establishment, Div. of Human Sciences, Linkoeping, Sweden
**Modern Color Vision Issues in Military Operational Environments**
Andersson, Patrik; Andersson, Peter; Jun. 1999; ISSN 1104-9154; 42p; Reserapport Fraen Kursen: Modern Color Vision Issues in Military Operational Environemnts. Vid CIMA: Centro de Instruccion de Medicina Aeroespacial Marid, Spanien 20-22 Juli 1998
Report No.(s): PB2001-108095; FOA-R-99-01273-706-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Color perception was discussed from the perspective of applied military use. There were talks about how many colors that should be used on a display in military vehicle and what colors should be used for special purposes (example: red for warning). Color coding affect the time it takes for the pilot or driver to find the exact instrument on the display he is looking for. A problem discussed was the use of laser and laser protection used by military personnel. Laser protection alters colors that can be a major problem in some situations. The environment for military personnel contains other factors that can affect performance. Examples of such factors are G-load, vibration, and different light conditions. Another topic discussed and demonstrated was screening: what

instruments should be used, when can you state that a person has a color defect or when can you state that he doesn't? The participants (40-50) came from Spain, England, France, the Netherlands, Norway, USA, and Sweden.
NTIS
*Color Coding; Color Vision; Display Devices*

**20020018868** Institute for Human Factors TNO, Soesterberg, Netherlands
**Cold Injury Risk With Marines** ***Final Report Koudeletselrisico bij Mariniers***
Daanen, H. A. M., Institute for Human Factors TNO, Netherlands; Jul. 31, 2001; 15p; In Dutch; Original contains color illustrations
Contract(s)/Grant(s): 013.20353; TNO Proj. 789.2
Report No.(s): TD-2001-0157; TM-01-A050; Copyright; Avail: Issuing Activity

The human extremities show the lowest temperatures during operations in cold environments. to prevent the occurrence of local cold injuries, humans have an effective mechanism called Cold Induced Vasodilatation (CIVID). If the local tissue temperature becomes too low, the muscles around the blood vessels relax and blood passes through, giving heat to the tissues. Large differences occur between subjects in the magnitude of this response and thus in the risk for cold injuries. The Royal Netherlands Navy asked TNO to investigate the cold injury risk in as many mariners as possible. A total of 226 marines immersed their left middle finger in ice water for 30 minutes. The finger skin temperature for all as well as the oral temperature in 94 subjects was measured. The risk index for frostbite (RIF) was measured on the basis of the finger skin temperature response. The index ranged from 3 (high risk) to 9 (low risk) dependent on the response time and response magnitude. The calculated RIF was relatively good as compared to Japanese males (7.0 +/- 1.7 versus 5.7 +/- 1.7). Smokers had an unexpected better RIF-score than non-smokers. It is likely that the risk for cold injuries increases during smoking in the cold due to the vasoconstriction. Whites generally have better RIF values, but in this study the results were not significant. Subjects with considerable pain after 10 minutes immersion generally had higher risk factors for cold injury. Pain therefore can be considered as an indicator for increased frostbite risk. The oral temperature had no relation with the RIF-score. Evaluation of the RIF-factors of marines that develop cold injuries during operations in the cold yields information on the validity of the RIF. Also, data on dexterity is gathered, that can be compared to dexterity scores in the cold. It is expected that marines with good RIF scores may have a better dexterity in the cold due to the relative warm fingers.
Author
*Frostbite; Body Temperature; Risk; Skin Temperature (Biology); Cold Tolerance; Human Performance; Fingers*

**20020018872** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Human Vulnerability and Medical Consequences: Penetrating Fragment Injuries** ***Final Report***
Verhagen, T. L. A., Prins Maurits Lab. TNO, Netherlands; Huisjes, H., Prins Maurits Lab. TNO, Netherlands; Hoogendoorn, H. A., Central Military Hospital, Netherlands; August 2001; 73p; In English; Original contains color illustrations
Contract(s)/Grant(s): A99/KL/441; TNO Proj. 014.13031
Report No.(s): TD-2001-0041; PML-2001-A41; Copyright; Avail: Issuing Activity

This study was started to become conversant with the opportunities of the Computer-Man simulation software tool as well as to evaluate its ability to determine the medical state of an individual person after (multiple) fragment impact. The use of the Abbreviated Injury Score (AIS) and the Injury Severity Score (ISS) in combination with visualization enable the military medical society to understand the medical consequences of fragment impact. The views are comparable to those traditionally used in the field of Vulnerability/Lethality studies, which are based on the probability of kill. ComputerMan simulations enable the military medical society to improve the medical support of military engagements. This can serve as a starting point for higher order quantitative as well as qualitative casualty rate estimations, and finally to improve the medical logistic support infrastructure. Above, ComputerMan also incorporates the traditional feature of predicting the probability of kills; which correspond with the traditional Kokinakis-Sperazza equations based values, because both are based on the same database. With this study we have shown that Computer-Man enables to present the effects of fragmenting injuries in terms of medical (AIS, ISS) as well as military (Probability of Kill's) consequences.
Author
*Computerized Simulation; Injuries; Lethality; Probability Theory; Vulnerability; Applications Programs (Computers); Diagnosis*

**20020019007** Chicago Medical School, Chicago, IL USA

**International Body Movement Along Three Axes Resulting from Externally Applied Sinusoidal Forces** ***Final Report, 31 May-30 Nov. 1963***

Nickerson, John L.; Drazic, Milana; Jul. 1966; 19p; In English

Contract(s)/Grant(s): AF 33(657)-10748

Report No.(s): AD-A397077; AMRL-TR-66-102; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents the results of observations on the resonance frequency and damping of a number of internal visceral body structures determined when the whole body is exposed to vibrations along three axes of the body. The X-ray method used is a modification of the system developed earlier. The results, using anesthetized dogs, are as follows. Along the long axis of the body, (Z), the resonance frequency and damping are the average respectively 4.4 cycles per second and 0.29 of the critical value. However, on axes at right angles to the long axis of the body, i.e., the transverse axis, (Y), and the dorso-ventral axis, (X), the values are respectively 9.1 and 8.9 cycles per second for the resonant frequency and 0.35 and 0.37 for the damping factor along the corresponding axes.

DTIC

*Vibration; Human Body*

**20020019039** National Defence Research Establishment, Div. of Human Sciences, Linkoeping, Sweden

**Faergseende under Hoeg +Gz-Belastning (Color Vision During High +Gz-Load)**

Balldin, U.; Derefeldt, G.; Eriksson, L.; Werchan, P.; Yates, T.; Oct. 2000; 22p; In Swedish

Report No.(s): PB2002-100831; FOA-R-00-016644-706-SE; Copyright; Avail: National Technical Information Service (NTIS)

The study has been carried out at US Air Force Research Laboratory (AFRL), Brooks Air Force Base, San Antonio, Texas. It was part of Annex D in a Memorandum of Agreement 'Cooperative Research and Development Efforts in the Field of Air Crew Protection and Performance' between US Air Force and Defence Materiel Administration, Sweden. It has been accomplished as a collaboration between National Defence Research Establishment, Department of Human Studies, Linkoping, Sweden and AFRL, Brooks AFB. In the earlier literature there are sporadic information about hue shifts at increased G-loads. The purpose of this study was to investigate if color vision is affected by high G z-loads up to +9 G z. Ten male subjects of whom nine had normal vision and on a slight color vision deficiency took part in the study. All were accustomed to high G z-loads in a human centrifuge. Each subject was exposed to a total of 60 G z-exposures with 10 s periods at +3, +5, +7, and +9 G z in the centrifuge during three different days. G-onset rate was 6G/s. Straining maneuvers were used if necessary and the subjects wore an anti-G suit. Five squared color stimuli of medium saturation (yellow, red, blue, green, and gray) were projected on a screen in front of the subject, who orally gave his hue response.

NTIS

*Color Vision; Loads (Forces); Acceleration (Physics); Human Centrifuges; Gravitation*

**20020019557** Walter Reed Army Inst. of Research, Div. of Preventive Medicine, Washington, DC USA

**AMSARA: Accession Medical Standards Analysis and Research Activity 2000 Annual Report**

Krauss, Margot R.; Niebuhr, David; Trofimovich, Lily; Powers, Timothy; Yuanzhang, Li; Jan. 2001; 92p; In English; Original contains color images

Report No.(s): AD-A397004; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Accession Medical Standards and Research Activity (AMSARA) has completed its fourth year of providing the DoD (Department of Defense) with evidence-based evaluations of accession standards. Included in this report are studies on asthma, mental health conditions, early hospitalization and rehabilitation of injured recruits. The first study demonstrates that recruits Waived for a history of asthma were more likely to remain on active duty than those who did not need a waver to enter active duty. Those Waived for a history of attention deficit disorder remain on active duty as long as matched controls. However those Waived for other mental health disorders are at increased risk for both psychiatric hospitalization and attrition. However, stricter standards might screen out many recruits who would do well on active duty in order to prevent an excess loss of approximately nine recruits per year. Mental health conditions are major reason for early hospitalization and early loss. 25.5% of all individuals hospitalized within the first six months have a mental health diagnosis. 70% to 96% of those hospitalized with a mental health condition leave the service within the next six months. This report also includes an analysis of the Physical Training Rehabilitation Program at Fort Jackson. Descriptive data on all applicants to the US military, the recruits entering active duty service, EPTS discharges, early hospitalizations and disability discharges are also included. Collaborative efforts with the Centers for Disease Control and Prevention, the National Institute of Mental Health and the University of Michigan are described.

DTIC

*Personnel Selection; Armed Forces (USA); Standards; Physical Fitness; Mental Health*

**20020019558** Walter Reed Army Inst. of Research, Div. of Preventive Medicine, Washington, DC USA

**AMSARA: Accession Medical Standards Analysis and Research Activity 1999 Annual Report**

Krauss, Margot R.; Trofimovich, Lily; Powers, Timothy; Li, Yuanzhang; Jan. 2000; 133p; In English; Original contains color images

Report No.(s): AD-A397005; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Accession Medical Standards and Research Activity (AMSARA) has completed its third year of providing the DoD (Department of Defense) with evidence-based evaluations of accession standards. Included in this report are three completed studies related to accession standards. The first is a retrospective review of the impact of waiving for a variety of back conditions. Attrition from all causes is not unusually high for individuals Waived for back conditions entering the Navy and Marines. Another completed study comparing recruits Waived for skin conditions to matched controls demonstrated these recruits are statistically more likely to experience some medical event. Additional studies on hospitalizations revealed enlisted females have 15% more hospitalizations (excluding childbirth and its complications) during the first 12 months of duty. The first phase of attrition modeling demonstrated that being a female is independently associated with a significantly higher rate of attrition. Being white, having dependents, having a medical disqualification at MEPS and being married are all independent risk factors for attrition. Descriptive data on applicants to the US military, the recruits entering active duty service, EPTS discharges, early hospitalizations and disability discharges are also included. In addition, ongoing studies and new initiatives are described.

DTIC

*Personnel Selection; Biomedical Data; Information Systems; Armed Forces (USA)*

**20020020361** NASA Marshall Space Flight Center, Huntsville, AL USA

**Cancer Risk Assessment for Space Radiation**

Richmond, Robert C., NASA Marshall Space Flight Center, USA; Cruz, Angela, NASA Marshall Space Flight Center, USA; Bors, Karen, NASA Marshall Space Flight Center, USA; [2001]; 2p; In English; International Workshop on Micro and Mini Dosimetry and Its Applications, 16-20 Dec. 2001, Sydney, Australia; No Copyright; Avail: Issuing Activity; Abstract Only

Predicting the occurrence of human cancer following exposure to any agent causing genetic damage is a difficult task. This is because the uncertainty of uniform exposure to the damaging agent, and the uncertainty of uniform processing of that damage within a complex set of biological variables, degrade the confidence of predicting the delayed expression of cancer as a relatively rare event within any given clinically normal individual. The radiation health research priorities for enabling long-duration human exploration of space were established in the 1996 NRC Report entitled 'Radiation Hazards to Crews of Interplanetary Missions: Biological Issues and Research Strategies'. This report emphasized that a 15-fold uncertainty in predicting radiation-induced cancer incidence must be reduced before NASA can commit humans to extended interplanetary missions. That report concluded that the great majority of this uncertainty is biologically based, while a minority is physically based due to uncertainties in radiation dosimetry and radiation transport codes. Since that report, the biologically based uncertainty has remained large, and the relatively small uncertainty associated with radiation dosimetry has increased due to the considerations raised by concepts of microdosimetry. In a practical sense, however, the additional uncertainties introduced by microdosimetry are encouraging since they are in a direction of lowered effective dose absorbed through infrequent interactions of any given cell with the high energy particle component of space radiation. Additional information is contained in the original extended abstract.

Derived from text

*Cancer; Exposure; Extraterrestrial Radiation; Radiation Dosage; Risk*

## 53
## BEHAVIORAL SCIENCES

*Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.*

**20020016491** NASA Ames Research Center, Moffett Field, CA USA

**Direction of Perceived Motion and Eye Movements Show Similar Biases for Asymmetrically Windowed Moving Plaids**

Beutter, B. R., NASA Ames Research Center, USA; Mulligan, J. B., NASA Ames Research Center, USA; Stone, L. S., NASA Ames Research Center, USA; [1995]; 1p; In English; Association for Research in Vision and Ophthalmology Meeting, 14-19 May 1995, Fort Lauderdale, FL, USA; Sponsored by Association for Research in Vision and Ophthalmology, USA

Contract(s)/Grant(s): RTOP 199-18-12-07; No Copyright; Avail: Issuing Activity; Abstract Only

We have shown that moving a plaid in an asymmetric window biases the perceived direction of motion (Beutter, Mulligan & Stone, ARVO 1994). We now explore whether these biased motion signals might also drive the smooth eye-movement response by comparing the perceived and tracked directions. The human smooth oculomotor response to moving plaids appears to be driven

by the perceived rather than the veridical direction of motion. This suggests that human motion perception and smooth eye movements share underlying neural motion-processing substrates as has already been shown to be true for monkeys.
Derived from text
*Bias; Eye Movements; Motion Perception*

**20020017454** NASA Ames Research Center, Moffett Field, CA USA
**Spatial Factors in the Integration of Speed Information**
Verghese, P., NASA Ames Research Center, USA; Stone, L. S., NASA Ames Research Center, USA; [1995]; 1p; In English; Association for Research in Vision and Ophthalmology Meeting, 14-19 May 1995, Fort Lauderdale, FL, USA; Sponsored by Association for Research in Vision and Ophthalmology, USA
Contract(s)/Grant(s): RTOP 199-18-12-07; No Copyright; Avail: Issuing Activity; Abstract Only

We reported that, for a 21FC task with multiple Gabor patches in each interval, thresholds for speed discrimination decreased with the number of patches, while simply increasing the area of a single patch produced no such effect. This result could be explained by multiple patches reducing spatial uncertainty. However, the fact that thresholds decrease with number even when the patches are in fixed positions argues against this explanation. We therefore performed additional experiments to explore the lack of an area effect. Three observers did a 21FC speed discrimination task with 6 Gabor patches in each interval, and were asked to pick the interval in which the gratings moved faster. The 50% contrast patches were placed on a circle at 4 deg. eccentricity, either equally spaced and maximally separated (hexagonal array), or closely-spaced, in consecutive positions (string of pearls). For the string-of-pearls condition, the grating phases were either random, or consistent with a full-field grating viewed through multiple Gaussian windows. When grating phases were random, the thresholds for the hexagonal and string-of-pearls layouts were indistinguishable. For the string-of-pearls layout, thresholds in the consistent-phase condition were higher by 15 +/- 6% than in the random-phase condition. (Thresholds increased by 57 +/- 7% in going from 6 patches to a single patch of equivalent area.). For random-phase patches, the lower thresholds for 6 patches does not depend on a specific spacing or spatial layout. Multiple, closely-spaced, consistent-phase patches that can be interpreted as a single grating, result in thresholds closer to that produced by a single patch. Together, our results suggest that object segmentation may play a role in the integration of speed information.
Author
*Layouts; Segments; Spacing; Circles (Geometry)*

**20020018147** Air Force Research Lab., Human Effectiveness Directorate, Wright-Patterson AFB, OH USA
**Combat Automation Requirements Testbed (CART): An Example Application** ***Interim Report, Mar.-Jul. 2001***
Carretta, Thomas R.; Doyal, Jeffrey A.; Craig, Karen A.; Aug. 2001; 54p; In English; Prepared in cooperation with Science Applications International Corporation
Contract(s)/Grant(s): AF Proj. 7184
Report No.(s): AD-A396871; AFRL-HE-WP-TR-2001-0151; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Combat Automation Requirements Testbed (CART) environment is an evolving software tool used to develop human performance models and integrate them with constructive simulations (CS) to address human performance modeling questions. An informal study was conducted to determine the level of effort required by naive users to use the CART software to answer research questions, identify areas where the software and supporting materials could be improved, and evaluate the utility of CART for addressing research questions normally tackled in virtual simulations (VS). Although model development was time consuming, much of this activity would need to be done whether researchers were using VS or CS. Regardless of method used, it would be prudent for researchers to develop detailed mission scenarios and task sequences and make educated estimates of time and workload requirements. The difference between resource requirements for VS and CS studies occurs in the activities that come next. In VS, hardware and software must be developed and subject-matter-experts testbed. In CS, the remainder of the work is mostly software development. The level of effort depends on the desired fidelity of the model and whether or not it is to 'stand alone' or interact with a VS environment. Several usability issues should be addressed before CART is widely distributed. Perhaps most important, the CART software and supporting materials are poorly documented. This is exacerbated by the non-intuitive nature of the CART user interface. Most researchers will require substantial assistance from CART software experts to fully-utilize the software. An easy to follow user's manual, pop-up menus, and Help function would go a long way toward making CART more user friendly and accessible to researchers.
DTIC
*Combat; Software Engineering; Computer Programming; Performance Prediction; Mathematical Models*

**20020018153** South Carolina Univ., Dept. of Psychology, Columbia, SC USA
**Contributions to the Development of VE-Assisted Training of Spatial Behavior** ***Final Report, 15 Jun. 1999-31 Dec. 2000***
Allen, Gary L.; Dec. 01, 2001; 24p; In English
Contract(s)/Grant(s): N00014-99-1-0928
Report No.(s): AD-A396850; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An initial three-part effort aimed at integrating spatial cognition research with virtual environment technology resulted in: (1) a conceptual framework for classifying spatial abilities into three ”families” (object identification. wayfinding & orientation, and target acquisition/avoidance); (2) results from an experimental study showing that global and local-object frames of reference are optimal for communicating direction of movement in fixed-observer situation; and (3) results from an experimental study showing that distance estimation skill could be trained using visual feedback and transferred to novel settings. Follow-up work focused on training estimation of distance and direction. A series of experimental studies showed that skill in estimating perceived and traversed distance can be trained using digital photographs and that this skill is transferable to novel settings. These findings support the use of VE-based techniques for training fundamental spatial skills relevant to military applications.
DTIC
*Perception; Virtual Reality; Human Performance*

**20020018866** Institute for Human Factors TNO, Soesterberg, Netherlands
**How to Compose a PsyOps Message, Part 3, The Effects of Medium and Emotionality on Persuasion** ***Interim Report***
Janssen, H. J. W., Institute for Human Factors TNO, Netherlands; Griffioen-Young, H. J., Institute for Human Factors TNO, Netherlands; Jul. 18, 2001; 31p; In English
Contract(s)/Grant(s): 013.40340; TNO Proj. 791.2
Report No.(s): TD-2001-0153; TM-01-A046; Copyright; Avail: Issuing Activity

Within the Defense Program ’Assessing the utility of NLW for the Netherlands’ armed forces’, TNO Human Factors is conducting research on the development and the effectiveness of methods to be used in PsyOps. The main goal of this research is optimizing persuasive messages for use in PsyOps missions. Specifically, we examined the effects of medium and emotionality on persuasion and attitude change. After subjects indicated their opinion regarding a certain topic, they received information about this topic in either written form or audio-visual form. This information was either accompanied by emotional images or not. After evaluating this information in terms of its emotionality, persuasiveness and importance, subjects were asked to indicate their opinion regarding the topic once again. In general, subjects were more persuaded by high emotional information than low emotional information. However, their attitudes were more susceptible to change by high emotional information when attitude strength was low than when attitude strength was high. Furthermore, the medium that was used to present the information did not have any effect on the amount of attitude change. These results confirm our expectations that the persuasiveness of a message depends on the attitude strength of the receiver. In the case of strong attitudes, and thus high involvement, attitudes can best be changed by the use of strong and convincing arguments. Conversely, in the case of weak attitudes, and thus low involvement, attitudes can best be changed by manipulating the emotionality of the message or manipulating contextual factors.
Author
*Emotional Factors; Military Operations; Defense Program; Psychological Effects; Messages*

## 54
## MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

*Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..*

**20020015755** Georgia Inst. of Tech., Center for Human-Machine Systems Research, Atlanta, GA USA
**Mode Transitions in Glass Cockpit Aircraft: Results of a Field Study**
Degani, Asaf, Georgia Inst. of Tech., USA; Kirlik, Alex, Georgia Inst. of Tech., USA; [1995]; 2p; In English; 6th IFAC/IFIP/IFORS/IEA Symposium on Analysis, Design and Evaluation of Man-Machine Systems, Jun. 1995, Boston, MA, USA; Sponsored by International Federation of Automatic Control, Unknown; No Copyright; Avail: Issuing Activity; Abstract Only

One consequence of increased levels of automation in complex control systems is the presence of modes. A mode is a particular configuration of a control system that defines how human command inputs are interpreted. In complex systems, modes also often determine a specific allocation of control authority between the human and automated systems. Even in simple static devices (e.g., electronic watches, word processors), the presence of modes has been found to cause problems in either-the

acquisition or production of skilled performance. Many of these problems arise due to the fact that the selection of a mode causes device behavior to be mediated by hidden internal state information. For these simple systems, many of these interaction problems can be solved by the design of appropriate feedback to communicate internal state information to the human operator. In complex dynamic systems, however, the design issues associated with modes seem to trancend the problem of merely communicating internal state information via displayed feedback. In complex supervisory control systems (e.g., aircraft, spacecraft, military command and control), a key function of modes is the selection of a particular configuration of control authority between the human operator and automated control systems. One mode may result in full manual control, another may result in a mix of manual and automatic control, while a third may result in full automatic control over the entire system. The human operator selects an appropriate mode as a function of current goals, operating conditions, and operating procedures. Thus, the operator is put in a position of essentially trying to control two coupled dynamic systems: the target system itself, and also a highly complex suite of automation controlling the target system. From a historical perspective, it should probably not come as a surprise that very little information is available to guide the design of mode-oriented control systems. The topic of function allocation (i.e., the proper division of control authority among human and computer) has a long history in human-machine systems research. Although this research has produced some relevant guidelines, a design approach capable of defining appropriate allocations of control function between the human and automation is not yet available. As a result, the function allocation decision itself has been allocated to the operator, to be performed in real-time, in the operation of mode-oriented control systems. A variety of documented aircraft accidents and incidents suggest that the real-time selection and monitoring of control modes is a weak link in the effective operation of complex supervisory control systems. Research in human-machine systems and human-computer interaction has barely scraped the surface of the problem of understanding how operators manage this task.The purpose of this paper is to present the results of a field study which examined how operators manage mode selection in a complex supervisory control system. Data on mode engagements using the Boeing B757/767 auto-flight system were collected during approach and descent into four major airports in the East Coast of the USA. Protocols documenting mode selection, automatic mode changes, pilot actions, quantitative records of flight-path variables, and verbal reports during and after mode engagements were collected by an observer from the jumpseat. Observations were conducted on two typical trips between three airports. Each trip was be replicated 11 times, which yielded a total of 22 trips and 66 legs on which data were collected. All data collected concerned the same flight numbers, and therefore, the same time of day, same type of aircraft, and identical operational environments (e.g., ATC facilities, weather patterns, traffic flow etc.)

Author

*Complex Systems; Control Systems Design; Air Traffic Control; Automatic Control; Automatic Pilots; Cockpits; Human-Computer Interface*

**20020016107** Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA

**Swatch Test Results of Commercial Chemical Protective Boots to Challenge by Chemical Warfare Agents** ***Final Report, Mar.-Sep. 1999***

Lindsay, Robert S.; Oct. 2001; 43p; In English

Report No.(s): AD-A396541; ECBC-TR-166; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Swatches from nine commercially available chemical protective boots were challenged with liquid droplets of sarin (GB) and mustard (HD) using modifications of the static diffusion described in TOP 8-2-501. The cumulative mass of each agent that permeated each swatch was determined over time, and the results for all swatches were used to determine an average cumulative mass for each boot. From these data, a breakthrough time was calculated for each boot/agent combination for purposes of comparisons.

DTIC

*Chemical Warfare; Diffusion; Boots (Footwear)*

**20020016108** Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA

**Test Results of Phase 2 Level B Suits to Challenge by Chemical and Biological Warfare Agents and Simulants** ***Final Report, Jan.-Sep. 1999***

Lindsay, Robert S.; Pappas, Alex G.; Oct. 2001; 86p; In English

Report No.(s): AD-A396534; ECBC-TR-185; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Swatches from seven commercially available Level B protective suits were challenged with liquid droplets of sarin (GB) and mustard (HD), using modifications of the static diffusion procedure described in TOP 8-2-501. The cumulative mass of each agent that permeated each swatch was determined over time, and the results for all swatches were used to determine a weighted-average cumulative mass for each suit. From these data, a breakthrough time was calculated for each suit for comparison purposes. In

addition, intact suits were challenged with corn-oil aerosol to simulate a biological or chemical aerosol. Protection factors were determined for each suit.
DTIC
*Protective Clothing; Chemical Warfare; Drops (Liquids); Destructive Tests*

**20020016273** Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA
**Test Results of Phase 2 Level A Suits to Challenge by Chemical and Biological Warfare Agents and Simulants** ***Final Report, Jan.-Sep. 1999***
Lindsay, Robert S.; Pappas, Alex G.; Oct. 2001; 77p; In English
Report No.(s): AD-A396575; ECBC-TR-187; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
Swatches from six commercially available Level A protective suits were challenged with liquid droplets of sarin (GB) and mustard (HD), using modifications of the static diffusion procedure described in TOP 8-2-501. The cumulative mass of each agent that permeated each swatch was determined over time, and the results for all swatches were used to determine a weighted average cumulative mass for each suit. From these data, a breakthrough time was calculated for each suit for comparison purposes. In addition, intact suits were challenged with corn-oil aerosol to simulate biological and chemical aerosols. Protection factors were determined for each suit.
DTIC
*Destructive Tests; Chemical Warfare; Protective Clothing*

**20020016294** Pacific Northwest National Lab., Richland, WA USA
**Independent Evaluation of The Lepestok Filtering Facepiece Respirator**
Hoover, M. D.; Vargo, G. J.; Jul. 24, 2001; 27p; In English
Report No.(s): DE2001-787352; PNNL-13581; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The purpose of this study was to determine the protection factor of the Lepestok-200 filtering facepiece respirator by conducting a standard quantitative fit test on a panel of 25 representative adults (14 males and 11 females) using the TSI Incorporated PortaCount PlusTM quantitative fit-testing system. Each subject was tested four times. In the total of 100 tests, 95% of the overall fit factors were greater than 3, more than 80% of the overall fit factors were greater than 14, approximately 50% were greater than 86, and 20% were greater than 200. The pass-fail performance of the respirator was similar for each of the six exercises in the test series: (1) normal breathing, (2) deep breathing, (3) moving the head side to side, (4) moving the head up and down, (5) reading a passage of text out loud, and (6) normal breathing, indicating that the respirator performs equally well for each type of exercise. A significant and sustained improvement in fit factor was observed after the initial test, indicating that the subjects benefited from the knowledge gained in the first of the four quantitative fit tests. In the 75 tests conducted after the initial test for each individual, 95% of the overall fit factors were greater than 6, more than 80% of the overall fit factors were greater than 23, and 50% were greater than 116, and 20% were greater than 200. Thus, the initial learning experienced doubled the fit factor for subsequent tests. In addition, there is an indication that the Lepestok-200 may perform better on wearers with wider faces than on individuals with narrower faces. The results of this study demonstrate the effectiveness of the Lepestok-200 respirator and reinforce the general conclusion that quantitative fit-testing can make an important contribution to ensuring that proper protection factors are achieved for workers.
NTIS
*Respirators; Face (Anatomy); Protective Clothing; Radiation Protection*

**20020016718** NASA Marshall Space Flight Center, Huntsville, AL USA
**Space Station Environmental Control and Life Support System Purge Control Pump Assembly Modeling and Analysis**
Schunk, R. Gregory, NASA Marshall Space Flight Center, USA; [2001]; 24p; In English; Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Preliminary results from a thermal/flow analysis of the Purge Control Pump Assembly (PCPA) indicate that pump performance (mass flow rate) is enhanced via cooling of the housing and lowering of the inlet vapor quality. Under a nominal operational profile (25% duty cycle or less), at the maximum motor dissipation, it appears that the peristaltic tubing temperature will still remain significantly below the expected UPA condenser temperature (78 F max versus approximately 105 F in the condenser) permitting condensation in the pump head.
Derived from text
*Environmental Control; Life Support Systems; Thermal Analysis; Pumps; Computerized Simulation*

**20020016722** NASA Marshall Space Flight Center, Huntsville, AL USA

**An Analysis of an Automatic Coolant Bypass in the International Space Station Node 2 Internal Active Thermal Control System**

Clanton, Stephen E., Sverdrup Technology, Inc., USA; Holt, James M., NASA Marshall Space Flight Center, USA; [2001]; 21p; In English; Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A challenging part of International Space Station (ISS) thermal control design is the ability to incorporate design changes into an integrated system without negatively impacting performance. The challenge presents itself in that the typical ISS Internal Active Thermal Control System (IATCS) consists of an integrated hardware/software system that provides active coolant resources to a variety of users. Software algorithms control the IATCS to specific temperatures, flow rates, and pressure differentials in order to meet the user-defined requirements. What may seem to be small design changes imposed on the system may in fact result in system instability or the temporary inability to meet user requirements. The purpose of this paper is to provide a brief description of the solution process and analyses used to implement one such design change that required the incorporation of an automatic coolant bypass in the ISS Node 2 element.

Author

*Temperature Control; Control Systems Design; Environmental Control; Design Analysis; Bypasses*

**20020018148** Air Force Research Lab., Human Systems Information Analysis Center, Wright-Patterson AFB, OH USA

**Status Update of Alternative Control and Display Technologies, Volume 1** ***Final Report***

Wourms, David F.; Mansfield, Lori; Cunningham, Paul H.; May 31, 2001; 95p; In English

Contract(s)/Grant(s): SPO700-98-D-4001

Report No.(s): AD-A396870; HSIAC-RA-2001-001-Vol-1; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This work was supported by the U.S. Army Research Laboratory, Human Engineering and Research Directorate (HRED) under the auspices of the Human Systems Information Analysis Center (HSIAC) Program Office. This effort was designed to determine the status and availability of alternative controls and displays for implementation within Army ground-based and airborne systems. To that end, it provides a broad baseline of information on speech-based/auditory; eye- and head-based; gesture/tactile; and biopotential technologies. Where the literature was lacking, subject-matter experts were contacted to determine technology status and assess its relevance to the improvement of soldier performance. An Alternative Control and Display Technology Matrix was developed to compile and summarize the subject matter expert/source survey results. This matrix contains technology descriptions, point of contact and/or web source information, estimated technology maturity/availability level, and perceived benefits to the warfighter as stated in the technology description or subject matter contact results. In addition, web sites, papers, or other sources identified that may be of interest for further independent investigation are listed.

DTIC

*Display Devices; Human Factors Engineering; Information Systems; Systems Analysis; Control Theory*

**20020018613** Naval Postgraduate School, Monterey, CA USA

**Implications of User Identification Devices (UIDS) for the USA Navy**

Haynes, Letitia D.; Sep. 2001; 72p; In English

Report No.(s): AD-A397013; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Various technologies are emerging to provide enhanced, automated personnel identification capabilities. Techniques for human microchip implants using radio frequency identification are possible, but the implications of this technology remain to be considered. This thesis provides a survey of current technologies for enhanced user identification, focusing on human implant approaches, and to summarize the set of security, privacy, social and ethical issues that may arise from the use of these technologies in the U.S. Navy. Technical background is presented to provide the reader with a basic understanding of radio frequency technology. An analysis of human implant technologies currently used in the private sector is provided to show how they might offer capabilities in the military. Applications of information technology and human microchip implants that may improve user identification in the future are presented and analyzed. Finally, a review of the social and ethical implications of human implant-based user identification is provided. It shows that the collateral social issues are complex and far-reaching, and need to be carefully considered by the Navy to avoid becoming entangled in intractable technical, morale and legal issues far into the future. The results of this exploratory thesis show: 1) implementation of advanced information technology devices must be carefully balanced against human social and ethical considerations; and 2) there is a valid need for future research and analysis of human microchip implants.

DTIC

*Identifying; Chips (Electronics); Implantation; Human Beings*

**20020019084** Institute for Human Factors TNO, Soesterberg, Netherlands

**Human Modelling Systems in Ship Design, Phase 2, Case Studies** ***Interim Report Mensmodellen in Hat Scheepsontwerpproces, Fase 2, Casestudies***

Punte, P. A. J., Institute for Human Factors TNO, Netherlands; Sep. 25, 2001; 62p; In Dutch; Original contains color illustrations

Contract(s)/Grant(s): 013.28352; TNO Proj. 789.1

Report No.(s): TD-2001-0160; TM-01-A053; Copyright; Avail: Issuing Activity

The ergonomic quality of a design determines safety, health, comfort, and functionality of ships. Digital human models enable an ergonomic evaluation of a ship before It is actually build. by order of the Royal Netherlands Navy, TNO Human Factors investigates the benefits of the use of digital human models in the design process of ships. This second phase of the project focuses on the differences between the main commercial available human modelling systems. We also showed the possibility to define the Dutch population in these models. To take into account the life-span of ships, we defined the body dimensions of the Dutch population in the years 2000, 2015, and 2030. to do this, we made use of statistical data concerning secular growth and shrink of the current population. To illustrate the use of digital human models during the design process, we showed a couple of case studies; the evaluation of a ship bridge, a navigation console, and a narrow passage between a machine room and a funnel. The ship bridge is used to show the evaluation of passage between consoles, sight between operators, and maintenance of consoles. The case of the navigation console showed the application of digital human models to evaluate sitting and standing comfort, reachability and visibility of Instruments, and outside view. Finally, the evaluation of the narrow passage showed the evaluation of escape routes during damage control. There is not much difference between the functionality of the four most promising digital human models (BHMS, RAMSIS, Safework, and Jack). For a successful use of a digital human model, the compatibility of the model with the existing in-company design software, such as Computer Aided Design tools, is very important. We concluded that it is impossible to carry out evaluations by using digital human models without the knowledge of an experienced ergonomic designer, Therefore, the investment in time and money to introduce a digital human model depends on the model itself, as well as on the education of the designers that are supposed to use the software. For the last phase of the project 'Human modelling systems in ship design', it has been recommended to investigate in what way physical load can be calculated using human modelling systems, taking into account the movements of the ship.

Author

*Human Factors Engineering; Ships; Systems Engineering; Computer Aided Design; Models*

**20020019088** Institute for Human Factors TNO, Soesterberg, Netherlands

**Human Factors Aspects of Information Operations: Starting Point TNO Human Factors** ***Interim Report Human Factors Aspecten van Informatie Operaties: Startnotitie TNO-TM***

vanderKleij, R., Institute for Human Factors TNO, Netherlands; Jansen, E. J. M., Institute for Human Factors TNO, Netherlands; Griffioen-Young, H. J., Institute for Human Factors TNO, Netherlands; Kerstholt, J. H., Institute for Human Factors TNO, Netherlands; Aug. 20, 2001; 22p; In Dutch

Contract(s)/Grant(s): 013.4035; 013.40345; TNO Proj. 791.2

Report No.(s): TD-2001-0158; TM-01-A051; Copyright; Avail: Issuing Activity

Central to the Defence Research programme, the development of Information Operations for the Armed Forces' is the protection of one's own information systems and the disruption of those of the opponent. On one hand this is approached from a technical perspective. On the other there is a need for knowledge about the workings of Information Operations from a human factors perspective. In this study we outline problems and research topics in the field of Information Operations, in which the human factor is the main focus. The results of the present study will provide direction for subsequent research within the framework of the research program. We conducted a literature study and held interviews with experts within the various Armed Forces services and related organizations such as Military Intelligence and the Royal Military Academy. Interviewees were chosen who represented political, strategic, operational and tactical functions within the armed forces organization. In this way we were able to identify wishes and problems in the area of Information Operations. Our findings show a great diversity of wishes and problems surrounding Information Operations.

Author

*Human Factors Engineering; Human Performance; Cognitive Psychology; Armed Forces; Information Systems*

**20020019090** Institute for Human Factors TNO, Soesterberg, Netherlands

**Effects of Temporal Blinding on Pilot Flight Performance** ***Interim Report***

Toet, A., Institute for Human Factors TNO, Netherlands; Walraven, J., Institute for Human Factors TNO, Netherlands; Alferdinck, J. W. A. M., Institute for Human Factors TNO, Netherlands; Wennemers, A. S., Institute for Human Factors TNO, Netherlands; Oct. 17, 2001; 29p; In English; Original contains color illustrations

Contract(s)/Grant(s): 013.39325; TNO Proj. 786.1
Report No.(s): TD-2001-0165; TM-01-A058; Copyright; Avail: Issuing Activity

On behalf of the Royal Netherlands Air Force we investigated how brief (1s) high intensity flash insults (e.g. a strobing laser) affect pilot flight performance. Pilots performed a simulated pursuit flight. During the flight they also performed two secondary tasks. The combination of at these tasks resulted in a high cognitive and visual workload. During the flight they were exposed to bursts of five consecutive intense light flashes, presented at random intervals. Several performance metrics were monitored to measure the effects of the flash insults. The pilots felt disrupted by the flash insults and experienced afterimages. However, we observed no effect of high intensity flash exposure on the accuracy in the pursuit task and the secondary cognitive tasks. As a protection strategy most pilots closed their eyes after the first flash in each burst of five. Pilot performance in high-workload flight tasks is robust against brief flash insults, at least under the conditions tested. Closing the eyelids may serve as a protection strategy for brief flash insults. Other possible protection strategies are (1) training pilots to make reflexive We movements away from the light source, and (2) installing a laser warning system in combination with a 3D audio warning signal.
Author
*Pilot Performance; Human Factors Engineering; Flight Simulators; Visual Perception; Flash Blindness; Flight Characteristics*

**20020019408** General Accounting Office, Washington, DC USA
**CONTRACT MANAGEMENT: Update on DoD's Purchase of Black Berets**
Sessions, Jeff; Dec. 2001; 12p; In English
Report No.(s): AD-A397209; GAO-02-165; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On May 2, 2001, we testified on Defense Logistics Agency (DLA) efforts to purchase black berets for Army forces. These purchases responded to the Army's announcement, in October 2000, that Army personnel would begin wearing berets 8 months later. In an effort to respond to the Army's requirement in the limited% time provided, DLA contracted for production of nearly 5 million berets at a cost of about $30 million. In the process, DLA shortcut normal contracting procedures and Waived restrictions, contained in the so-called "Berry Amendment, " that limit Department of Defense (DOD) purchases of certain items, including clothing, to those produced in the USA or its possessions. Despite these efforts, DLA was unable to meet the Army's deadline, and it terminated three contracts because the contractors did not meet delivery requirements. In response to your request, we followed up on our earlier work in order to assess the current status of the black beret procurement as well as the status of DOD's efforts to ensure proper waivers of the Berry Amendment. to date, DOD has received about 2.1 million berets-less than 1 million of which were distributed to Army personnel. DOD still expects another 1.6 million berets to be delivered by September 2002. DOD has also taken steps to ensure that proposed waivers of the Berry Amendment are considered at an appropriate management level. DOD no longer allows the Under Secretary of Defense (Acquisition, Technology and Logistics) or the service secretaries to delegate their authority to approve Berry Amendment waivers. Requests for waivers must also be supported by analyses of why alternatives that would not require a waiver were unacceptable. Since these requirements were set, the Under Secretary has approved six waivers, all of which originated at the Defense Logistics Agency. Because DOD is taking actions to ensure proper waivers of the Berry Amendment, we are not making recommendations.
DTIC
*Defense Program; Logistics; Clothing; Contract Management*

## 59
## MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

*Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see categories 60 through 67.*

**20020016417** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Ghost cell expansion method for reducing communications in solving PDE problems**
Ding, C. H. Q.; He, Y.; May 01, 2001; 11p; In English
Report No.(s): DE2001-783746; LBNL-47929; No Copyright; Avail: Department of Energy Information Bridge

In solving Partial Differential Equations, such as the Barotropic equations in ocean models, on Distributed Memory Computers, finite difference methods are commonly used. Most often, processor subdomain boundaries must be updated at each time step. This boundary update process involves many messages of small sizes, therefore large communication overhead. Here we propose a new approach which expands the ghost cell layers and thus updates boundaries much less frequently - reducing total message volume and grouping small messages into bigger ones. Together with a technique for eliminating diagonal

communications, the method speedup communication substantially, up to 170%. We explain the method and implementation in details, provide systematic timing results and performance analysis on Cray T3E and IBM SP.
NTIS
*Partial Differential Equations; Ghosts*

**20020016420** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Some remarks on unilateral matrix equations**
Cerchiai, B. L.; Zumino, B.; Feb. 01, 2001; 6p; In English
Contract(s)/Grant(s): DFG-CE-50/1-1
Report No.(s): DE2001-783741; LBNL-47482; No Copyright; Avail: Department of Energy Information Bridge
We briefly review the results of our paper LBNL-46775: We study certain solutions of left-unilateral matrix equations. These are algebraic equations where the coefficients and the unknown are square matrices of the same order, or, more abstractly, elements of an associative, but possibly noncommutative algebra, and all coefficients are on the left. Recently such equations have appeared in a discussion of generalized Born-Infeld theories. In particular, two equations, their perturbative solutions and the relation between them are studied, applying a unified approach based on the generalized Bezout theorem for matrix polynomials.
NTIS
*Algebra; Matrices (Mathematics)*

**20020018008** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Interpolation on Sparse Gaub-Chebyshev Grids in Higher Dimensions. Modelling, Analysis and Simulation**
Sprengel, F.; Nov. 1998; 22p; In English
Report No.(s): PB2001-108512; MAS-R9824; Copyright; Avail: National Technical Information Service (NTIS), Microfiche
In this paper, we give a unified approach to error estimates for interpolation on sparse GauB-Chebyshev grids for multivariate functions from Besov-type spaces with dominating mixed smoothness properties. The error bounds obtained for this method are almost optimal for the considered scale of function spaces.
NTIS
*Multivariate Statistical Analysis; Chebyshev Approximation; Error Analysis; Computational Grids*

**20020018176** Sandia National Labs., Albuquerque, NM USA
**Location Algorithms and Errors in Time-of-Arrival Systems**
Aaronson, E. A.; Sep. 01, 2001; 82p; In English
Report No.(s): DE2001-787610; SAND2001-2892; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This report describes least squares solution methods and linearized estimates of solution errors caused by data errors. These methods are applied to event locating systems which use time-of-arrival (TOA) data. Analyses are presented for algorithms that use the TOA data in a 'direct' manner and for algorithms utilizing Time-of-arrival Squared (TSQ) methods. Location and error estimation results were applied to a 'typical' satellite TOA detecting system. Using Monte Carlo methods, it was found that the linearized location error estimates were valid for random data errors with relatively large variances and relatively poor event/sensor geometries. In addition to least squares methods, which use an L(sub 2) norm, methods were described for L(sub 1) and L(sub (infinity)) norms. In general, these latter norms offered little improvement over least squares methods. Reduction of the location error variances can be affected by using information in addition to the TOA data themselves by adding judiciously chosen 'conditioning' equation(s) to the least squares system. However, the added information can adversely affect the mean errors. Also, conditioned systems may offer location solutions where non-conditioned scenarios may not be solvable. Solution methods and linearized error estimates are given for 'conditioned' systems. It was found that for significant data errors, the linearized estimates were also close to the Monte Carlo results.
NTIS
*Position (Location); Least Squares Method; Monte Carlo Method; Estimates*

**20020018846** Technische Univ., Centre for Technical Geoscience, Delft, Netherlands
**Equivalence of the Newton-Kantorovich and Distorted Born Methods**
Remis, R. F.; vandenBerg, P. M.; Oct. 1999; 14p; In English
Report No.(s): PB2002-100735; ET/EM-1999-17; Copyright; Avail: National Technical Information Service (NTIS)

We show that the Newton-Kantorovich and distorted Born methods for the computational solution of the non-linear inverse scattering problem are equivalent. This was already shown for the discrete matrix case. Here we present an analysis based on the analytic representations of the integral operators. We first briefly review both methods and then show that they are equivalent.
NTIS
*Integral Equations; Operators (Mathematics); Born Approximation; Inverse Scattering; Equivalence*

## 60
## COMPUTER OPERATIONS AND HARDWARE

*Includes hardware for computer graphics, firmware and data processing. For components see 33 Electronics and Electrical Engineering. For computer vision see 63 Cybernetics, Artificial Intelligence and Robotics.*

**20020016209** Sandia National Labs., Albuquerque, NM USA
**Programming Paradigms for Massively Parallel Computers: LDRD Project** ***Final Report***
Brightwell,; Jun. 01, 2001; 16p; In English
Report No.(s): DE2001-783090; SAND2001-1784; No Copyright; Avail: Department of Energy Information Bridge

This technical report presents the initial proposal and renewable proposals for an LDRD project whose intended goal was to enable applications to take full advantage of the hardware available on Sandia's current and future massively parallel supercomputers by analyzing various ways of combining distributed-memory and shared-memory programming models. Despite Sandia's enormous success with distributed-memory parallel machines and the message-passing programming model, clusters of shared-memory processors appeared to be the massively parallel architecture of the future at the time this project was proposed. They had hoped to analyze various hybrid programming models for their effectiveness and characterize the types of application to which each model was well-suited. The report presents the initial research proposal and subsequent continuation proposals that highlight the proposed work and summarize the accomplishments.
NTIS
*Distributed Memory; Massively Parallel Processors; Parallel Processing (Computers)*

**20020016340** Laval Univ., Computer Sciences Dept., Sainte-Foye, Quebec Canada
**Towards a Comparison Approach of Architectures for Interoperable Environments**
Elkadhi, Abdelhamid, Laval Univ., Canada; Moulin, Bernard, Laval Univ., Canada; Maamar, Zakaria, Zayed Univ., United Arab Emirates; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 13-1 - 13-10; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In this paper we propose an approach to compare different architectures for interoperable environments. We present four different architectures: three of them use stationary agents and well-known negotiation organizations (use of a broker agent, use of the contract net protocol), the fourth one uses mobile agents and a meeting infrastructure. We propose a comparison function based on three main factors (message type, message size and risk). We also present the approach that is used to compare the architectures considering various scenarios which influence the interactions between the different agents involved in the negotiation process supported by the various architectures.
Author
*Architecture (Computers); Interoperability; Protocol (Computers); Computer Programs*

**20020016344** Military Univ. of Technology, Warsaw, Poland
**The Role of NATO C3 Interoperability Testing Infrastructure to Establish the Polish Interoperability Architecture**
Amanowicz, M., Military Univ. of Technology, Poland; Gajewski, P., Military Univ. of Technology, Poland; Lubkowski, P., Military Univ. of Technology, Poland; Lysek, K., Military Univ. of Technology, Poland; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 17-1 - 17-11; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The need to improve interoperability at all levels of Consultation, Command and Control (C3) support, including areas from political consultation to tactical battlefield operations, remains the most important question for NATO (North Atlantic Treaty Organization). This is a main statement of NATO Policy for C3 Interoperability (NC3IP) that provides nations, NATO Military Authorities and other NATO bodies that will support their efforts to enhance C3 interoperability and achieve standardization objectives according to the NATO Interoperability Framework (NIF). In order to achieve and to maintain C3 interoperability the concept for NATO Interoperability Environment Testing Infrastructure (NIETI) was developed. The scope of NIETI is to support

the life cycle testing of NATO Interoperability Environment (NIE) elements and operational interoperability within NATO and with Allied systems, including Partnership for Peace (PfP) nations by collecting, analyzing and managing interoperability data and making tests and demonstrations to provide specific interoperability information. According to this all nations are working out their interoperability requirements and making tests, which are able to confirm this requirements. The Polish interoperability requirements derive from NC3IP and NIETI. In this paper the authors describe the NIETI process that includes gathering, managing and analyzing data. They also present its impact on the development of the Polish Communications and Information Systems (CIS) interoperability testing infrastructure which was established in the Communications Systems Institute (CSI) of the Military University of Technology (MUT). In the paper authors briefly describe some experiments, which were performed in collaboration with NATO C3 Agency.
Author
*Interoperability; Command and Control; North Atlantic Treaty Organization (NATO); Communication Networks; Information Systems*

**20020017459** De Montfort Univ., Milton Keynes, UK
**Trends in Embedded Systems Master Class**
Jul. 14, 2000; 401p; In English
Contract(s)/Grant(s): F61775-00-WF086
Report No.(s): AD-A396822; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche
The Final Proceedings for Master Class in Current Trends in Embedded DSP systems, 7 July 2000 - 14 July 2000. The objective of the Master Class is to teach researchers of the latest advances in digital signal processing. Topics include: (a) Embedded systems, where are we now and where are we going? (b) Basic principles of embedded systems. (c) Benefits of digital signal processing (DSP) systems for multimedia applications. (d) Hardware/software co-design issues and solutions. (e) Mapping algorithms to architectures and their implementation in multimedia systems.
DTIC
*Signal Processing; Digital Systems; Computer Programs; Trends*

**20020018611** Naval Postgraduate School, Monterey, CA USA
**Integrating a Trusted Computing Base Extension Server and Secure Session Server into the LINUX Operating System**
Glover, Mark V.; Sep. 2001; 84p; In English
Report No.(s): AD-A397015; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The Multilevel Secure Local Area Network (MLS LAN) Project at the Naval Postgraduate School's Center for Information Security (INFOSEC) Studies and Research (NPS CISR) is building a trusted network system that is both necessary and sufficient to provide a multilevel networking solution for real world use. The current configuration provides the necessary trusted network services on the TCSEC Class B-3 evaluated XTS-300, which is a combination of the STOP version 4. 4.2 multilevel secure operating system, and a Wang-supplied Intel x86 hardware base. The interface for the STOP operating is based on the System V.3 UNIX implementation System V.3 lacks many of features available in more modern UNIX implementations such as System V.4 and BSD 4.3, and also lacks many of the features in POSIX and ANSI C standards, Finally, the CPU is several generations older than the more current Intel processors. This thesis discusses the port of several MLS trusted network services on the XTS-300 to a Linux operating system running on an Intel Pentium Processor, The new Linux TCBE Server configuration will permit further experimentation with MLS architectural issues in a more modern, flexible and easily modifiable environment The port was accomplished by identifying and modifying the necessary software modules needed, to adapt to a Linux environment This thesis proves that XTS-300 TCB services can be ported to Linux system without any negative effects on performance thus allowing a move toward a more security enhanced implementation.
DTIC
*UNIX (Operating System); Computer Information Security; Architecture (Computers)*

**20020020973** Naval Postgraduate School, Monterey, CA USA
**Web-Based Testing Tools for Electrical Engineering Courses**
Briggs, Jaime; Sep. 2001; 134p; In English; Original contains color images
Report No.(s): AD-A397129; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
This thesis presents a distance-learning tool, which provides a self-sufficient application that allows one to implement online courses for electrical engineering. A major emphasis is placed on replacing simplistic multiple-choice or true-false test questions. A system named, Distance Learning Tools for Online Tests (DLTOT) is designed, modeled and implemented. The implementation is based on the Java programming language, using Servlets and Java Server Pages (JSP), three-tier technology and Commercial

Off-the-Shelf (COTS) products, namely, an Apache web server, Tomcat Application server, Microsoft Access, Mathematica, WebMathematica and JSP/ Servlet technology. DLTOT is able to control student access, to allow interaction with the student during the course, and to present a challenging test, which is easily graded by the application itself.
DTIC
*Education; On-Line Systems; Electrical Engineering*

## 61
## COMPUTER PROGRAMMING AND SOFTWARE

*Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.*

**20020016105** Geological Survey, Biological Resources Div., Reston, VA USA
**A Framework for Ecological Decision Support Systems: Building the Right Systems and Building the Systems Right**
DErchia, Frank; Korschgen, Carl; Nyquist, Maury; Root, Ralph; Stine, Peter; Jun. 2001; 56p; In English
Report No.(s): AD-A396555; USGS/BRD/ITR--2001-0002; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
Workshops in the late 1990's launched the commitment of the US Geological Survey's Biological Resources Division (BRD) to develop and implement decision support systems (DSS) applications. One of the primary goals of this framework document is to provide sufficient background and information for Department of the Interior (DOI) bureau stakeholders and other clients to determine the potential for DSS development. Such an understanding can assist them in carrying out effective land planning and management practices. This document provides a definition of DSS and its characteristics and capabilities. It proceeds to describe issues related to meeting resource managers needs, such as the needs for specific applications, customer requirements, information and technology transfer, user support, and institutionalization. Using the decision process as a means to guide DSS development and determine users needs is also discussed. We conclude with information on methods to evaluate DSS development efforts and recommended procedures for verification and validation.
DTIC
*Decision Support Systems; Procedures; Resources Management*

**20020016198** California Univ., Berkeley, CA USA
**Message passing vs. shared address space on a cluster of SMPs**
Shan, H.; Singh, J. P.; Oliker, L.; Biswas, R.; Jan. 22, 2001; 8p; In English
Report No.(s): DE2001-787126; LBNL-47806; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The emergence of scalable computer architectures using cluster of PCs (or PC-SMPs) with commodity networking has made them attractive platforms for high-end scientific computing. Currently, message passing (MP) and shared address space (SAS) are the two leading programming paradigms for these systems. MP has been standardized with MPI, and is the most common and mature parallel programming approach. However, MP code development can be extremely difficult, especially for irregularly structured computations. SAS offers substantial ease of programming, but may suffer from performance limitations due to poor spatial locality and high protocol overhead.
NTIS
*Architecture (Computers); Message Processing; Distributed Processing; Computer Systems Design; Computer Networks*

**20020016199** California Univ., Berkeley, CA USA
**Ordering sparse matrices for cache-based systems**
Biswas, R.; Oliker, L.; Jan. 11, 2001; 3p; In English
Report No.(s): DE2001-787125; LBNL-47805; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The Conjugate Gradient (CG) algorithm is the oldest and best-known Krylov subspace method used to solve sparse linear systems. Most of the floating-point operations within each CG iteration is spent performing sparse matrix-vector multiplication (SPMV). We examine how various ordering and partitioning strategies affect the performance of CG and SPMV when different programming paradigms are used on current commercial cache-based computers. However, a multi-threaded implementation on the cacheless Cray MTA demonstrates high efficiency and scalability without any special ordering or partitioning.
NTIS
*Algorithms; Linear Equations; Parallel Programming; Linear Systems*

**20020016200** California Univ., Berkeley, CA USA

**Design strategies for irregularly adapting parallel applications**

Oliker, L.; Biswas, R.; Shan, H.; Sing, J. P.; Nov. 01, 2000; 3p; In English

Report No.(s): DE2001-787124; LBNL-47804; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Achieving scalable performance for dynamic irregular applications is eminently challenging. Traditional message-passing approaches have been making steady progress towards this goal; however, they suffer from complex implementation requirements. The use of a global address space greatly simplifies the programming task, but can degrade the performance of dynamically adapting computations. In this work, we examine two major classes of adaptive applications, under five competing programming methodologies and four leading parallel architectures. Results indicate that it is possible to achieve message-passing performance using shared-memory programming techniques by carefully following the same high level strategies.

NTIS

*Applications Programs (Computers); Parallel Programming; Memory (Computers); Messages*

**20020016244** General Atomics Co., San Diego, CA USA

**Data Analysis Software Tools for Enhanced Collaboration at the DIII-D National Fusion Facility**

Schachter, J.; Peng, Q.; Schissel, D. P.; Jul. 01, 1999; 21p; In English; 2nd IAEA Technical Committee Meeting on Control, Data Acquisition and Remote Participation on Fusion Research, 19-21 July 1999, Lisbon, Portugal

Contract(s)/Grant(s): AC03-99ER54463

Report No.(s): DE2001-766927; GA-A23187; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Data analysis at the DIII-D National Fusion Facility is simplified by the use of two software package in analysis codes. The first is GAPlotObj, an IDL-based object-oriented library used in visualization tools for dynamic plotting. GAPlotObj gives users the ability to manipulate graphs directly through mouse and keyboard-driven commands. The second software package is MDSplus, which is used at DIII-D as a central repository for analyzed data GAPlotObj and MDSplus reduce the effort required for a collaborator to become familiar with the DIII-D analysis environment by providing uniform interfaces for data display and retrieval. Two visualization tools at DIII-D that benefit from them are ReviewPlus and EFITviewer. ReviewPlus is capable of displaying interactive 2D and 3D graphs of raw, analyzed, and simulation code data. EFITviewer is used to display results from the EFIT analysis code together with kinetic profiles and machine geometry. Both bring new possibilities for data exploration to the user, and are able to plot data from any fusion research site with an MDSplus data server.

NTIS

*Applications Programs (Computers); Computerized Simulation; Data Management; Tokamak Devices; Data Processing Equipment*

**20020016366** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**CEBAF beam viewer imaging software**

Bowling, B. A.; McDowell, C.; May 01, 1993; 3p; In English

Report No.(s): DE2001-787849; CEBAF-PR-93-036; DOE/ER/40150-1920; No Copyright; Avail: Department of Energy Information Bridge

This paper discusses the various software used in the analysis of beam viewer images at CEBAF. This software, developed at CEBAF, includes a three-dimensional viewscreen calibration code which takes into account such factors as multiple camera/viewscreen rotations and perspective imaging, and maintaining a calibration database for each unit. Additional software allows single button beam spot detection, with determination of beam location, width, and quality, in less than three seconds. Software has also been implemented to assist in the determination of proper chopper RF control parameters from digitized chopper circles, providing excellent results.

NTIS

*Monitors; Imaging Techniques; Beams (Radiation); Particle Acceleration; Computer Programs*

**20020016411** Lawrence Livermore National Lab., Livermore, CA USA

**AMBER user's manual**

Vay, J. L.; Fawley, W.; Nov. 08, 2000; 53p; In English

Report No.(s): DE2001-783867; LBNL/PUB-3160; No Copyright; Avail: Department of Energy Information Bridge

AMBER is a Particle-In-Cell (PIC) code which models the evolution of a representative slice of a relativistic electron beam in a linear accelerator. The beam is modeled as a steady flow and therefore no electromagnetic waves: all the fields (external and self-fields) are electrostatic and magnetostatic fields. The possible elements describing the accelerator lattice are solenoids, accelerating gaps, pipes and apertures. Several kinds of beam distribution can be loaded: KV, gaussian, semi-gaussian, etc.

Alternatively, the user can reconstruct (or load) a distribution from the output of another codefile, for example, an interface generating the beam distribution from output produced from EGUN or LSP codes is available as an option. This documentation first describes in detail the input files needed to run AMBER and the procedure to start the executable. The possible data files and graphical output are explained in the two following chapters. The last chapter describes the physics model and numerical techniques used. An example of input files and the result obtained with these inputs are also given.
NTIS
*Relativistic Electron Beams; User Manuals (Computer Programs); Computerized Simulation*

**20020017416** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**Techniques for Reduced Order Modeling of Aeoelastic Structures with Deforming Grids**
Anttonen, John S.; Oct. 2001; 157p; In English
Report No.(s): AD-A396816; AFIT/DS/ENY/01-01; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Reduced order modeling (ROM) seeks to make the modeling of aeroelastic behavior practical by reducing computation time for design codes. Deforming grids are often used in aeroelastic problems to account for the deformation of the structure. Proper Orthogonal Decomposition (POD/ROM) is a ROM technique that operates in an index-space for computations, not accounting for changes in grid dynamics, and must be modified to reflect grid deformation properly. To investigate and account for the effects of grid deformation on POD/ROM, a new algorithm is developed that incorporates modifications to the usual formulation. Evaluation of the new algorithm is accomplished through application to three fluid-structure models, each adding an increased level of grid dynamics. Deforming grid POD/ROMs are found to require more modes for an accurate solution than POD/ROM for rigidly moving grids. In addition, for deforming grids, POD/ ROMs are less accurate when the grid deformation is significantly altered from the deformations seen in the development of the POD/ROM. A technique, called Multi-POD, is developed that evaluates the relative grid motion between how the POD/ROM is created and how it is executed. The Multi-POD technique determines the current relative grid deformation and selects the best POD/ROM from those available.
DTIC
*Grids; Aeroelasticity; Computer Aided Design; Computational Grids; Algorithms*

**20020017692** National Aerospace Lab., Amsterdam, Netherlands
**Collaborative Engineering Environments. Two Examples of Process Improvement**
Spee, J. B. R. M.; Bijwaard, D. J. A.; Laan, D. J.; Jan. 2001; 14p; In English
Report No.(s): PB2001-108845; NLR-TP-98600; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Companies are recognising that innovative processes are determining factors in competitiveness. Two examples from projects in aircraft development describe the information collaborative engineering environments as a way to improve engineering processes. An engineering process management system allows engineering teams to work concurrently in tasks, following a defined flow of activities, applying tools on a shared database. Automated management of workspaces including data consistency enables engineering teams to concentrate on the design activities. The huge amount of experience in companies must be transformed for effective application in engineering processes. Compatible concepts, notations and implementation platforms make tangible knowledge like models and algorithms accessible. Computer-based design management makes knowledge on engineering processes and methods explicit.
NTIS
*Engineering Management; Computer Aided Design; Management Systems; Aircraft Design; Automatic Control*

**20020018033** Alabama Univ., Huntsville, AL USA
**Optical Interface Assembly for TOW Trainer** ***Final Report, 11 Aug. 1999-30 Sep. 2000***
Geary, Joseph; Reardon, Patrick; Nov. 13, 2001; 23p; In English
Contract(s)/Grant(s): DAAH01-97-D-R005
Report No.(s): AD-A396804; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Software Engineering Directorate constructed a target acquisition training module that replaces the tactical target acquisition head attached to a TOW missile launcher. Soldiers can train on this tactical simulator without expending costly munitions. The module contains a large LCD panel upon which real time scenery, moving targets, and scene movements (coordinated with launcher pointing) are presented to the gunner trainee via the standard TOW tactical 'monocular' eyepiece. This paper discusses the design and prototyping of the optical interface assembly that connects the LCD to the gunner's tactical eyepiece so that the trainee sees a realistic presentation. A mandatory constraint dictated that only off-the-shelf optics be employed for the prototype. A half-wave retarder is also incorporated in the beam path to alleviate polarization effects. The completed system

met the design specifications, cost, and schedule constraints. It also provides a practical (and digestible) example of the optical engineering art for students embarking on this career path.
DTIC
*Design Analysis; Prototypes; Training Devices; Missile Launchers*

**20020018034** Alabama Univ., Huntsville, AL USA
**Javelin EPBST Software Development** ***Final Report, 10 Dec. 1998-30 Dec 1999***
Dow, Stephen J.; Oct. 15, 2001; 11p; In English
Contract(s)/Grant(s): DAAH01-97-D-R005
Report No.(s): AD-A396803; 5-20417; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This task continued work on a new trainer for the Javelin weapon system, called the Enhanced Producibility Basic Skills Trainer (EPBST). The author's work was part of a team effort which transformed early prototype software into a full implementation of the EPBST requirements. This report provides an overview of the EPBST software and detailed discussion of the methods used to display scenes containing terrain and moving targets.
Author
*Computer Programming; Prototypes; Software Engineering; Training Devices; Weapon Systems*

**20020018035** Alabama Univ., Huntsville, AL USA
**Trainer Software Development** ***Final Report, 5 May-31 Dec. 1998***
Dow, Stephen J.; Oct. 15, 2001; 6p; In English
Contract(s)/Grant(s): DAAH01-97-D-R005
Report No.(s): AD-A396802; 5-20135; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This task continued work toward development of a new trainer for the Javelin weapon system and focused on incorporating a system for rendering three dimensional models of targets into the previous prototype software.
Author
*Computer Programming; Software Engineering; Three Dimensional Models; Training Devices; Weapon Systems*

**20020018180** Atomic Energy Commission, Hanford Operations Office, Washington, DC USA
**Virtual Library Software Requirements Specification**
deLamare, M. A.; Sep. 20, 2001; 46p; In English
Report No.(s): DE2001-787580; BHI-01534; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This document identifies the system level requirements for the Virtual Library. The Virtual Library is being developed to support the scientific, engineering, and management users of critical Hanford Site data.
NTIS
*Computer Programs; Specifications; Libraries*

**20020018569** Stanford Linear Accelerator Center, CA USA
**LIBXSIF, A Standalone Library for Parsing the Standard Input Format**
Tenenbaum, P. G.; Jul. 27, 2001; 4p; In English
Report No.(s): DE2001-787210; SLAC-PUB-8936; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The Standard Input Format for the description of accelerator beamlines has achieved limited acceptance due to the complexity of the parser required. We describe a standalone library of FORTRAN-90 routines which can be used to parse a superset of the Standard Input format in use at SLAC, named Extended Standard Input Format (XSIF). This library provides authors of new simulation codes with a simple means of adding XSIF compatibility to their programs, and also permits users to add their own features to the parser with relative ease. As examples we describe the manner in which the linear accelerator code LIAR was modified to use LIBXSIF, and changes made to DIMAD to switch from its internal Standard Input Format parser to use of the external XSIF parser. URL's for the source code, documentation, and ready-to-use libraries are provided.
NTIS
*Computerized Simulation; Linear Accelerators; Beams (Radiation); Parsing Algorithms; Applications Programs (Computers)*

**20020018833** Research Inst. of National Defence, Div. of Human Sciences, Linkoeping, Sweden

**Log-File Visualisation: An Aid to Business Model Evaluation** ***Visualisering av Loggiler-ett Hjaelpmedel foer Utvaerdering av Verksamhetsmodeller***

Albinsson, P. A.; Oct. 2000; 81p; In Swedish

Report No.(s): PB2002-100692; FOA-R-00-0189-201-SE; Copyright; Avail: National Technical Information Service (NTIS)

Within the scope of the army's tactical command and control system (ATCCS), process and object modelling has been central work method. For evaluation of these business models, observational data-collected by officers during military exercises-is being used. The command and control systems are increasingly computerized, which adds the possibility of logging. This report covers whether data visualization of collected log-files can be used as a complement to existing methods. One business model where data collection research is being done is the ground combat model. Having this model as a reference, data visualization methods were designed with time lines, map presentation and graphs as the main concept. An important part of the work is the co-ordination possibilities of the visualization methods. Paper mock-up prototypes were designed and evaluated during two military exercises. The results were favorably received by both model evaluators and model designers, giving grounds for further research concerning analysis of information need and prototype implementation.

NTIS

*Scientific Visualization; Mathematical Models; Command and Control; Prototypes; Commerce; Logarithms*

**20020018875** Federal Aviation Administration, Office of Aviation Research, Washington, DC USA

**Review of Pending Guidance and Industry Findings on Commercial Off-the-Shelf (COTS) Electronics in Airborne Systems**

Thornton, Robert K.; Aug. 2001; 125p; In English

Contract(s)/Grant(s): DTFA03-99-C-00030

Report No.(s): AD-A397034; DOT/FAA/AR-01/41; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The intent of this report is to provide findings about the state of the industry relative to the design objectives identified in guidance document DO-254 with focus on the implications for the use of commercial off-the shelf (COTS) electronic hardware components in safety critical airborne systems. The use of complex electronic hardware components in airborne systems poses a challenge to the meeting of safety requirements because, for complex components, complete verification is, at best, very difficult and, at worst, not achievable. In order to address the potential lack of complete verification, it is recommended that the hardware design life cycle processes should include design assurances to mitigate the possibility that design errors may be introduced into the hardware component and cause anomalous behavior. New technologies, being developed in the commercial sector, could provide enhanced safety in airborne systems if the technologies could be incorporated at an affordable cost. However, the use of COTS components in airborne systems raises a number of issues with respect to meeting airborne system safety requirements and DO-254 objectives. Commercial market trends are rapidly diverging from the needs of safety critical airborne systems. Issues with respect to COTS usage may become barriers in certain cases, if necessary assurances cannot be achieved in a cost effective manner. The assurances required for high criticality applications such as levels A and B will probably not be attainable for COTS components without mitigation by other means.

DTIC

*Computer Programs; Commercial Off-The-Shelf Products; Systems Engineering*

**20020018917** Winston-Salem State Univ., Computer Science Dept., Winston-Salem, NC USA

**Generic Divide and Conquer Internet-Based Computing**

Radenski, Atanas, Winston-Salem State Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 44; In English; Also announced as 20020018881

Report No.(s): R36; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The rapid growth of internet-based applications and the proliferation of networking technologies have been transforming traditional commercial application areas as well as computer and computational sciences and engineering. This growth stimulates the exploration of new, internet-oriented software technologies that can open new research and application opportunities not only for the commercial world, but also for the scientific and high -performance computing applications community. The general goal of this research project is to contribute to better understanding of the transition to internet-based high -performance computing and to develop solutions for some of the difficulties of this transition. More specifically, our goal is to design an architecture for generic divide and conquer internet-based computing, to develop a portable implementation of this architecture, to create an example library of high-performance divide-and-conquer computing agents that run on top of this architecture, and to evaluate the performance of these agents. We have been designing an architecture that incorporates a master task-pool server and utilizes satellite computational servers that operate on the Internet in a dynamically changing large configuration of lower-end nodes

provided by volunteer contributors. Our designed architecture is intended to be complementary to and accessible from computational grids such as Globus, Legion, and Condor. Grids provide remote access to existing high-end computing resources; in contrast, our goal is to utilize idle processor time of lower-end internet nodes. Our project is focused on a generic divide-and-conquer paradigm and its applications that operate on a loose and ever changing pool of lower-end internet nodes.
Author
*Internets; Software Engineering*

**20020019006** Naval Postgraduate School, Monterey, CA USA
**The Design and Development of a Web-Interface for the Software Engineering Automation System**
McDonald, James A., III; Sep. 2001; 241p; In English
Report No.(s): AD-A397079; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The Software Engineering Automation System evolved from the Computer-Aided Prototyping System (CAPS) developed in the late 1980's and early 1990's to help software engineers rapidly produce working prototypes for hard real-time embedded systems. As software development methods such as the waterfall and spiral methods evolved the requirement for a system to prototype products became clear. CAPS was able to meet the needs of the software engineer, allowing them to edit the project, translate and compile the code, develop the interface, and execute the project. As the requirements change and customer's needs become clearer, the ability to rapidly change the prototype to meet these needs was met by the CAPS system. Today companies that are developing software systems are global in nature. Development could take place over a vast expanse of several continents. The change in the workplace environment bore the requirement to redesign SEAS to make it accessible globally as well as making it functional across multiple platforms. The envisioned redesign of the SEAS system takes the functionality of the current system and deploys it as a web application on the Internet.
DTIC
*Real Time Operation; Software Engineering; Automatic Control*

**20020019226** RECOM Technologies, Inc., Moffett Field, CA USA
**The Algorithm Selection Problem**
Minton, Steve, RECOM Technologies, Inc., USA; Allen, John, RECOM Technologies, Inc., USA; [1994]; 1p; In English; 1995 International Jount Conferences on Artificial Intelligence, 20-25 Aug. 1995, Montreal, Canada
Contract(s)/Grant(s): RTOP 233-03-05; No Copyright; Avail: Issuing Activity; Abstract Only

Work on NP-hard problems has shown that many instances of these theoretically computationally difficult problems are quite easy. The field has also shown that choosing the right algorithm for the problem can have a profound effect on the time needed to find a solution. However, to date there has been little work showing how to select the right algorithm for solving any particular problem. The paper refers to this as the algorithm selection problem. It describes some of the aspects that make this problem difficult, as well as proposes a technique for addressing it.
Author
*Algorithms; Computer Programs*

**20020019233** RECOM Technologies, Inc., Moffett Field, CA USA
**A Study on the Effect of Communication Performance on Message-Passing Parallel Programs: Methodology and Case Studies**
Sarukkai, Sekhar R., RECOM Technologies, Inc., USA; Yan, Jerry, RECOM Technologies, Inc., USA; [1994]; 1p; In English; 9th ACM International Conference on Supercomputing, 3-7 Jul. 1995, Barcelona, Spain; Sponsored by Association for Computing Machinery, USA
Contract(s)/Grant(s): NAS2-14088; RTOP 501-10-31; No Copyright; Avail: Issuing Activity; Abstract Only

From a source-program perspective, the performance achieved on distributed/parallel systems is governed by the underlying message-passing library overhead and the network capabilities of the architecture. Studying the impact of changes in these features on the source-program. can have a significant influence in the development of next-generation system designs. In this paper we introduce a simple and robust tool that can be used for this purpose. This tool is based on event-driven simulation of programs that generates a new set of trace events - that preserves causality and partial order - corresponding to the expected execution of the program in the simulated environment. Trace events can be visualized and source-level profile information can be used to pin-point locations of program which are most significantly affected with changing system parameters in the simulated environment. We present a number of examples from the NAS benchmark suite, executed on the Intel Paragon and iPSC/860 that

are used to identify and expose performance bottlenecks with varying system parameters. Specific aspects of the system that significantly effect these benchmarks are presented and discussed,
Author
*Parallel Processing (Computers); Communication Networks; Messages; Source Programs*

**20020019406** Single Integrated Air Picture System Engineering Task Force, Arlington, VA USA
**Single Integrated Air Picture (SIAP) Measures of Effectiveness (MOEs) and Measures of Performance (MOPs)**
Votruba, Paul; Nisley, Rich; Rothrock, Ron; Zombro, Brett; Oct. 2001; 30p; In English
Report No.(s): AD-A397221; SIAP SE TF TR 2001-002; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This technical report defines a precise set of measures of effectiveness (MOEs) that measure warfighting benefit and provides functional groupings of measures of performance (MOPs) that measure system performance as derived in the Theater Air & Missile Defense (TAMD) Integrated Architecture. It also establishes the context for MOP measurement and discusses the relationship between MOEs/MOPs and SIAP attributes.
DTIC
*Images; Missile Defense; Systems Integration; Computer Systems Performance; Architecture (Computers)*

**20020019407** Single Integrated Air Picture System Engineering Task Force, Arlington, VA USA
**Single Integrated Air Picture (SIAP) Attributes**
Votruba, Paul; Cartier, Joan; Rothrock, Ron; Zombro, Brett; Jun. 2001; 43p; In English; Original contains color images
Report No.(s): AD-A397215; SIAP SE TP TR 2001-001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This technical report establishes a minimal but sufficient set of Single Integrated Air Picture (SIAP) attributes with verbal and mathematical definitions that are derived from Capstone Requirements Documents (CRDs) and associated Key Performance Parameters (KPPs). These attributes will be used to relate proposed engineering improvements to warfighting capability.
DTIC
*Images; Mathematical Models; Systems Integration; Military Technology*

**20020019415** Space and Naval Warfare Systems Center, San Diego, CA USA
**On the Role of Randomization in Software Engineering**
Rubin, S. H.; Trajkovic, L.; Boerke, J.; Rush, R. J., Jr.; Mar. 2001; 7p; In English; Prepared in collaboration with Simon Fraser University, Vancouver, BC Canada. Published in Proceedings of the 28th Conference ICC&IE, 5-7 March 2001
Contract(s)/Grant(s): Proj. ZA01
Report No.(s): AD-A397122; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Randomization is defined to mean the removal of redundancy from information. In this sense, it is synonymous with information compression; although, randomization may extend beyond syntactic representation to include domain-specific semantic elements as well. This paper serves to make clear the ubiquitous role assumed by randomization in all aspects of software engineering - from programming language design to program design to testing. It goes on to show that the representation of knowledge in what is termed an expert compiler is critical to the degree of automation that can be attained. Moreover, knowledge-centric networks allow software developers an economy of scale in support of software reuse.
DTIC
*Redundancy; Software Engineering; Random Variables; Programming Languages*

**20020019560** Naval Postgraduate School, Monterey, CA USA
**Implementing the Naval Postgraduate School's Security Policy Using Windows 2000**
McKinley, David R.; Sep. 2001; 317p; In English
Report No.(s): AD-A397082; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche
When the Naval Postgraduate School (NPS) fully migrates to Microsoft Windows 2000 as the primary operating system on desktop PCs and servers, security configuration will be a major concern. Windows 2000 provides a consolidated tool set as a means to securely configure these systems. It also provides a pre-configured list of security templates that may be applied when initially configuring different types of systems. The purpose of this thesis is to provide: (1) brief overview of the Microsoft Windows 2000 security architecture, (2) a description of the Windows 2000 Security Configuration Tool Kit and how to configure security settings, (3) a discussion on security policy and how it effects security configurations, (4) recommendations on how to translate

the Naval Postgraduate School's Security Policy into Windows 2000 security settings, and (5) recommendations on a pre-configured, security template for all students attending NPS.
DTIC
*Navy; Architecture (Computers); Operating Systems (Computers); Computer Information Security*

**20020019801** Single Integrated Air Picture System Engineering Task Force, Arlington, VA USA
**Single Integrated Air Picture (SIAP) Metrics Implementation**
Votruba, Paul; Nisley, Rich; Rothrock, Ron; Zombro, Brett; Oct. 29, 2001; 65p; In English; Original contains color images
Report No.(s): AD-A397225; SIAP SE TF TR 2001-003; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Metrics have been identified to quantify a Single Integrated Air Picture (SIAP) in Technical Reports 2001-001 and 2001-002. Beyond the task of defining appropriate measures for quantifying the SIAP, however, it is essential to establish guidelines for implementation to ensure consistency in the evaluation and use of the measures. In particular, objective evaluation of the quantitative SIAP attribute measures, crucial to the process of assessing compliance with Theater Air and Missile Defense (TAMD) and Combat Identification (CID) Capstone Requirements Documents (CRDs), is dependent upon prior establishment of a track data base to measure and an rule for determining association of tracks with truth objects.
DTIC
*Missile Defense; Systems Engineering; Metrology; Systems Integration*

**20020019806** Naval Postgraduate School, Monterey, CA USA
**Integration of Personal Digital Assistant (PDA) Devices into the Military Healthcare Clinic Environment**
Keltner, Jason; Miller, Paul; Sep. 2001; 197p; In English
Report No.(s): AD-A397190; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The business drivers within managed care are mandating that physicians have point-of-care access to medical reference data, patient specific data, formularies, treatment protocols, and billing/coding information. One emerging technology that has the potential to provide this access with little economic investment is the mobile Personal Digital Assistant. The authors address a variety of wireless technologies and security concerns regarding real-time access to patient data. The family practice staff at the Naval Hospital Lemoore explored and contrasted the capabilities of commercially available PDAs, wireless interfaces, and medical software applications to ascertain their value within the Military Health System. A production-ready interface between the Composite Health Care System and the Nutrition Management Information Server demonstrates the potential for eliminating the difficulties associated with documenting patient encounters and capturing charges. Survey tools generate a requirements standard for deployment of this technology within the Military Health System on an enterprise-wide scale with a hybrid approach to packaging based on functionality. The authors recommend the Military Health System embrace this technology as a means to realize its vision of best value health services.
DTIC
*Systems Integration; Client Server Systems; Military Technology; Health Physics*

**20020019810** Naval Postgraduate School, Monterey, CA USA
**The Use of Knowledge Based Decision Support Systems in Reengineering Selected Processes in the U. S. Marine Corps**
Korzilius, Holly N.; Sep. 2001; 120p; In English
Report No.(s): AD-A397105; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In light of the continued investment in information technology by businesses in hopes of achieving a measurable benefit in terms of process efficiency and effectiveness, business process reengineering (BPR) is becoming increasingly important. BPR suggests that by radically redesigning underlying business processes, companies can achieve breakthrough improvements in productivity. BPR, however, is a knowledge intensive endeavor. A decision support tool called KOPeR-lite was developed with the intent of encoding the knowledge held by BPR experts and documented in BPR literature. This tool promises to assist BPR novices who are tasked with reengineering inefficient or ineffective processes. The purpose of this thesis is to determine the viability of using KOPeR-lite when BPR novices undertake process reengineering projects. It also proposes reengineering solutions for the permanent change of station orders process for USMC officers, which will be presented to the leadership in the Headquarter, U.S. Marine Corps (HQMC) Manpower and Reserve Affairs (M&RA) branch. If adopted, one of the proposed solutions promises to dramatically improve process performance.
DTIC
*Knowledge Based Systems; Decision Support Systems*

**20020019816** Naval Postgraduate School, Monterey, CA USA

**Developing Articulated Human Models from Laser Scan Data for Use as Avatars in Real-Time Networked Virtual Environments**

Dutton, James A.; Sep. 2001; 66p; In English

Report No.(s): AD-A397086; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

With the continuing gain in computing power, bandwidth, and Internet popularity there is a growing interest in Internet communities. to participate in these communities, people need virtual representations of their bodies, called avatars. Creation and rendering of realistic personalized avatars for use as virtual body representations is often too complex for real-time applications such as networked virtual environment (VE). Virtual Environment (VE) designers have had to settle for unbelievable, simplistic avatars and constrain avatar motion to a few discrete positions. The approach taken in this thesis is to use a full-body laser-scanning process to capture human body surface anatomical information accurate to the scale of millimeters. Using this 3D data, virtual representations of the original human model can be simplified, constructed and placed in a networked virtual environment. The result of this work is to provide photo realistic avatars that are efficiently rendered in real-time networked virtual environments. The avatar is built in the Virtual Reality Modeling Language (VRML). Avatar motion can be controlled either with scripted behaviors using the H-Anim specification or via wireless body tracking sensors developed at the Naval Postgraduate School. Live 3D visualization of animated humanoids is viewed in freely available web browsers.

DTIC

*Computerized Simulation; Human Body*

**20020020459** Naval Postgraduate School, Monterey, CA USA

**The Design, Simulation, and Fabrication of a BiCMOS VLSI Digitally Programmable GIC Filter**

Milne, Paul R.; Sep. 2001; 97p; In English; Original contains color images

Report No.(s): AD-A397177; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This thesis used a previously-designed programmable GIC filter as a basis in which to incorporate a BiCMOS operational amplifier. An NPN bipolar transistor layout was designed and incorporated into an opamp layout which was a modified version of a complementary metal oxide semiconductor (CMOS)-only design. The BiCMOS opamp was simulated using Silvaco SmartSpice and showed considerable improvement over its CMOS equivalent. Additional improvements were made to the GIC filter to include a passgate with reduced resistance and a correction was made to the capacitor layout. Simulations were also performed on a switched-capacitor bilinear resistor and a switched-capacitor variable bilinear resistor. Results from the bilinear resistor simulations require further study and testing. Finally a VLSI layout of the filter was accomplished using LASI and has been submitted to MOSIS for fabrication.

DTIC

*Capacitors; CMOS; Operational Amplifiers; Computerized Simulation*

**20020020467** Naval Postgraduate School, Monterey, CA USA

**Information Management System for Electronic Voting in Support of the Schieffelin Award for Excellence in Teaching**

Magliano, Samuel A.; Sep. 2001; 400p; In English

Report No.(s): AD-A397138; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

The purpose of this research was to evaluate, automate, refine, and develop a management information system that facilitated data collection, organization, query, analysis, and counting of ballots submitted over the Internet/intranet with regard to the Rear Admiral John J. Schieffelin Award for Excellence in Teaching. Research included conducting a detailed analysis of the current system (reengineering), preparing hardware and software requirements for an automated system, determining security requirements for an Intranet based voting system and implementing a prototype to demonstrate feasibility. The 'Rear Admiral John J. Schieffelin Award for Excellence in Teaching', has traditionally been a manual system interwoven with several legacy systems that make analysis, voter response and data collection difficult. Development of an Internet/intranet based Information System coupled with a Decision Support System for statistical analysis, streamlines the flow of information, thus allowing for more robust analysis/querying as well as possibly increasing voter response by providing a friendly user interface that allows quick and easy ballot submissions.

DTIC

*Computer Networks; Information Management; Management Information Systems; Voting*

**20020020471** Argonne National Lab., IL USA

**Three-Dimensional Modeling of a Time-of-Flight Mass Spectrometer: Optimization of SNMS/SIMS Transmission Using Simion**

Calaway, W. F.; Pellin, M. J.; Veryovkin, I. V.; Aug. 17, 1999; 7p; In English

Report No.(s): DE2001-11905; ANL/CHM/CP-99642; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A computer program that models secondary ion and post-ionized neutral trajectories through the Surface Analysis by Resonance Ionization of Sputtered Atoms (SARISA) instrument has been developed. The program has been tested by determining the transmission of secondary ions for two different ion energies. Results indicate that the model accurately reflects the transmission of the SARISA instrument. The developed algorithm for creating ions and monitoring their parameters is generic and can be used for examining other SIMS/SNMS (Secondary Ion Mass Spectrometry/Secondary Neutron Mass Spectrometry) instruments and ion sources.

NTIS

*Algorithms; Computer Programs; Three Dimensional Models; Time of Flight Spectrometers; Trajectories*

**20020020966** Naval Postgraduate School, Dept. of Computer Science, Monterey, CA USA

**Agent-Based Simulation of a Marine Infantry Squad in an Urban Environment**

Anagon, Arthur R.; Sep. 2001; 162p; In English; Original contains color images

Report No.(s): AD-A397278; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This thesis research focused on the design development and implementation of an agent-based simulation of a Marine infantry squad in an urban environment. The goal was to design an autonomous-agent framework that could model a combatant's decision cycle. A squad entity composed of these agents was created to explore the idea of team dynamics and the balance between meeting individual goals and team goals. The agents were placed in a two-dimensional, discrete-state, simulation world with a simple model of urban infrastructure. The squad goal was to patrol through the environment using checkpoints. The individual agent goals were to move to a destination and maintain the squad formation. The critical issues of agent movement were collision detection/avoidance, goal managing and forward planning. Distinguishing the agents by their role in the squad allowed a single agent to act as the squad leader. This agent was given the ability to plan a path to accomplish the squad's overall goal as a series of sub-goals, which was successful in getting the majority of the agents to their checkpoints in squad formation. The design of the simulation program facilitates further research in using autonomous agents to model small I-units in an urban environment.

DTIC

*Computerized Simulation; Cities; Warfare*

**20020020968** Naval Postgraduate School, Monterey, CA USA

**Electronic Maneuvering Board and Dead Reckoning Tracer Decision Aid for the Officer of the Deck**

Frantzen, Joey L.; Ehresman, Kenneth L.; Sep. 2001; 210p; In English

Report No.(s): AD-A397270; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The US Navy currently bases the majority of our contact management decisions around a time and manning intensive paper-based Maneuvering Board process. Additional manning requirements are involved on many Naval Ships in order to accurately convey the information to the OOD (Office On Deck) and/or the Commanding Officer. When given situations where there exist multiple contacts, the current system is quickly overwhelmed and may not provide Decision-Makers a complete and accurate picture in a timely manner. The purpose of this research is to implement a stand-alone system that will provide timely and accurate contact information for Decision-Makers. by creating a reliable, automated system in a format that is familiar to all Surface Warfare Officers, we will provide the Navy with a valuable decision-making tool, while increasing ease of data exchange and reducing current redundancies and manning inefficient practices. Our software design is based upon the Unified Modeling Language (UML). UML allows us to construct a software model that is supported by the Ada programming language. Our design is based upon these fundamental tenants: Non-Operating System dependent, Non-Hardware System dependent, Extensible and Modular design. Ada provides a certified compiler, making our code robust and assuring the 'buyer' that the program does what we advertise it to do.

DTIC

*Computer Programs; Decision Making; Personnel; Management; Ada (Programming Language)*

**20020020976** Naval Postgraduate School, Monterey, CA USA
**A Data Warehousing and OLAP Application for the Naval Reserve Force (CNRF) Assessment Process**
Langley, Scott A.; Sep. 2001; 138p; In English
Report No.(s): AD-A397109; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Naval Reserve Force has identified a need to pool the data from its many legacy database systems into a single useable data warehouse. The current system uses separate legacy databases and formatted reports to provide a manual decision process. Under the leadership of Rear Admiral John Totushek the Naval Reserve Force is driving many technological revolutions via the Leading Change initiative. One of the key goals of the Leading Change initiative is a strategic decision support tool. to support this goal Naval Reserve Force Assessment Division elected to find a project to provide a prototype data warehouse and Online Analytical Processing (OLAP) solution to the problem. The Naval Reserve Strategic Decision Support Tool (NaRSDAT) is the result. The NaRSDAT development of this thesis provides an in depth evaluation of the existing databases. It then provides an object oriented development approach to a relational data warehouse and a star schema development for data mining. NaRSDAT employs Microsoft Visual Basic Microsoft Access and Cognos PowerPlay to provide a complete data warehouse and OLAP solution. The NaRSDAT prototype will serve as the basis for a comprehensive knowledge management solution for the Naval Reserve Force.

DTIC

*Data Bases; Military Operations*

**20020021280** National Defence Research Establishment, Div. of Command and Control Warfare, Linkoeping, Sweden
**User's Guide for Dual Simulation between Missile and Ship: DSimRRu** ***Anvaendarhandlendning foer duellsimulering Mellan robot och Fartyg DSimRRu***
Colbin, D.; Johansson, P.; Strand, P.; Malmstroem, D. N. H.; Tubelius, C.; Aug. 2000; 60p; In Swedish
Report No.(s): PB2002-100644; FOA-R-00-01568-616-SE; No Copyright; Avail: National Technical Information Service (NTIS)

The Swedish Defence Research Establishment (FOA) has together with the Naval Centre (MarinC) developed a generic simulation model. The ambition is to increase the knowledge, in the Royal Swedish Navy, of electronic warfare (EW) in the duel between a radar surface-to-surface missile and a ship. This report describes the structure of the generic duel simulation model (Dsim), using the simulation tool ACSL/Graphic Modeller. Moreover it outlines how simulations can be visualised with the AFE programme. The objective is that persons, guided by the manual, should be able to handle the computers and run the simulation models without further assistance. This also accounts for those with limited background knowledge of simulation models and computer systems. The report describes some generic possible electronic warfare duel scenarios. The manual is currently unclassified. When correct system data for the missile, ship and EW equipment is added, the report itself is to be regarded as classified. The simulation is run by the use of a PC with Windows NT 4.0.

NTIS

*Ships; Computerized Simulation; User Manuals (Computer Programs); Surface to Surface Missiles*

## 62
## COMPUTER SYSTEMS

*Includes computer networks and distributed processing systems. For information systems see 82 Documentation and Information Science. For computer systems applied to specific applications, see the associated category.*

**20020016276** National Inst. of Standards and Technology, Computer Security Div., Gaithersburg, MD USA
**Report on the Development of the Advanced Encryption Standard (AES)**
Nechvatal, James; Barker, Elaine; Bassham, Lawrence; Burr, William; Dworkin, Morris; Oct. 02, 2000; 117p; In English; Original contains color images
Report No.(s): AD-A396556; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In 1997, the National Institute of Standards and Technology (NIST) initiated a process to select a symmetric-key encryption algorithm to be used to protect sensitive (unclassified) Federal information in furtherance of NIST's statutory responsibilities. In 1998, NIST announced the acceptance of fifteen candidate algorithms and requested the assistance of cryptographic research community in analyzing the candidates. This analysis included an initial examination of the security and efficiency characteristics for each algorithm. NIST reviewed the results of this preliminary research and selected MARS, RC6(TM), Rijndael, Serpent and

Twofish as finalists. Having reviewed further public analysis of the finalist, NIST has decided to propose Rijndael as the Advance Encryption Standard (AES). The research results and rationale for this selection are documented in this report.
DTIC
*Algorithms; Cryptography*

**20020016341** Military Univ. of Technology, Warsaw, Poland
**The Requirements for COTS IPv6 Network Applications in Tactical Network Environment**
Gajewski, Piotr, Military Univ. of Technology, Poland; Bajda, Artur, Military Univ. of Technology, Poland; Krygier, Jaroslaw, Military Univ. of Technology, Poland; Jarmakiewicz, Jacek, Military Univ. of Technology, Poland; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 14-1 - 14-8; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper deals with requirements related to the possibilities and limitations of using the commercial-off-the-shelf (COTS) IPv6 (Internet protocol, version 6)) components in tactical communications and information systems. It describes the requirements based on military communications network needs analyses. 'NATO C3 Technical Architecture' by NATO C3 (Command, Control, Communications) Board Information Systems Sub-committee is the main document used for COTS technology evaluation with respect to their application in military environment. Unfortunately, the COTS evaluation method has not been defined yet. They describe only required standard features such as: maturity, availability and stability. The quantitative and qualitative assessment criteria become essential from the following COTS exploitation point of view: quality of service, users' mobility, survivability, security, interoperability and management possibility. This paper describes all mentioned above assessment criteria and the IPv6 usage by COTS elements.
Author
*Command and Control; Commercial Off-The-Shelf Products; Communication Networks; Protocol (Computers); Armed Forces; Computer Networks*

**20020016350** SaabTech Systems A.B., Jaerfaella, Sweden
**Providing the Common View of the Situation: The WASP Approach**
Bergman, Niclas, SaabTech Systems A.B., Sweden; Wallenius, Klas, Royal Inst. of Tech., Sweden; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 23-1 - 23-9; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

New commercial network technology brings new cost-effective approaches to information distribution and information sharing. by sharing information, not only does planning and engagement become more efficient, but the information resources themselves also become better utilized. Information sharing allows for wider flexibility in the organizational structure, it decentralizes the decision making, giving faster reactions to new scenarios and unpredicted situations. Moreover, the strive towards a higher interoperability between coalition partners with more frequent and greater joint peace keeping activities also demands a higher level of information sharing. This paper presents the techniques and methodologies for information sharing that has been developed and evaluated within the WASP (Wide Area Situation Picture) project. The WASP system provides a solution based on a distributed and non-hierarchical infrastructure utilizing commercial network technology. The encapsulated software labelled the WASP Correlator Unit (WCU) is designed for easy integration into present systems and for co-operation with standardised NATO (North Atlantic Treaty Organization) links. The paper gives a brief technical overview of the WASP concept and highlights the system performance and functionality by means of results from simulations. The system features include automatic distributed track correlation with optional manual interaction, accurate estimation of data quality, and bandwidth control. The system also provides functionality for selective subscription to information with respect to its geographical origin and data accuracy. Data selection is obtained by use of multicast services in the network, giving each subscriber to the network the part of the global information that is of prime importance from his horizon. Simultaneously, each subscriber feeds the network with all information that will contribute to the global picture concerning both coverage and quality. The system provides global target numbering distributed to all subscribers. The quality of the common situation picture available in the network is naturally affected by the tracking performance at each subscriber feeding the network, but also by the network delay and target maneuverability. The data quality is therefore constantly estimated and monitored by each WCU. The system is fully scalable regarding the number of connected subscribers and due to the generality of the encapsulated WCU, the subscribers can be of fundamentally different types.
Author
*North Atlantic Treaty Organization (NATO); Computer Networks; Interoperability; Selective Dissemination of Information; Information Resources Management*

**20020016354** Defence Evaluation Research Agency, Malvern, UK

**Jini in Military System Applications**

Wilkinson, Tim, Defence Evaluation Research Agency, UK; Haines, Sue, Defence Evaluation Research Agency, UK; Williams, Craig, Defence Evaluation Research Agency, UK; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 12-1 - 12-18; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Jini is a distributed computing environment that extends the concept of 'plug-and-play' to networking. A Jini-enabled hardware or software component, or service, can be connected to a Jini network and announce its presence. Existing services on the network can be notified of the arrival of the new service and reconfigure themselves accordingly. Jini provides support for a client that wishes to use such a service, allowing it to locate the service and call on it to perform tasks. This paper is the output of a study to investigate the possible role that the Jini technology could play in the Joint battlespace. In particular, the paper explores Jini's ability to provide a robust, reliable, secure and scalable solution to network service provision, and details the benefits and limitations of Jini with recommendations of how those limitations may be overcome.

Author

*Military Technology; Computer Components; Distributed Processing; Computer Networks; Computer Information Security; Java (Programming Language)*

**20020016416** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**MPH: A library for distributed multi-component environment**

Ding, C. H. Q.; He, Y.; Jun. 01, 2001; 10p; In English

Report No.(s): DE2001-783747; LBNL-47930; No Copyright; Avail: Department of Energy Information Bridge

Many current large and complex HPC applications are based on semi-independent program components developed by different groups or for different purposes. On distributed memory parallel supercomputers, how to perform component-name registration and initialize communications between independent components are among the first critical steps in establishing a distributed multi-component environment. Here we describe MPH, a multi-component handshaking library that resolves these tasks in a convenient and consistent way. MPH uses MPI for high performance and supports many PVM functionality. It supports two major parallel integration mechanism: multi-component multi-executable (MCME) and multi-component single-executable (MCME). It is a simple, easy-to-use module for developing practical codes, or as basis for larger software tools/frameworks.

NTIS

*Multiprogramming; Distributed Memory; Supercomputers*

**20020016418** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Network Characterization Service (NCS)**

Jin, G.; Yang, G.; Crowley, B.; Agarwal, D.; Jun. 06, 2001; 11p; In English

Report No.(s): DE2001-783745; LBNL-47892; No Copyright; Avail: Department of Energy Information Bridge

Distributed applications require information to effectively utilize the network. Some of the information they require is the current and maximum bandwidth, current and minimum latency, bottlenecks, burst frequency, and congestion extent. This type of information allows applications to determine parameters like optimal TCP buffer size. In this paper, we present a cooperative information-gathering tool called the network characterization service (NCS). NCS runs in user space and is used to acquire network information. Its protocol is designed for scalable and distributed deployment, similar to DNS. Its algorithms provide efficient, speedy and accurate detection of bottlenecks, especially dynamic bottlenecks. On current and future networks, dynamic bottlenecks do and will affect network performance dramatically.

NTIS

*Computer Networks; Protocol (Computers)*

**20020018007** Center for Mathematics and Computer Science, Amsterdam Netherlands

**Parallel Iteration of the Extended Backward Differentiation Formulas. Modelling, Analysis and Simulation**

Frank, J. E.; van der Houwen, P. J.; May 1999; 20p; In English

Report No.(s): PB2001-108632; MAS-R99913; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

The extended backward differentiation formulas (EBDFs) and their modified form (MEBDF) were proposed by Cash in the 1990s for solving initial-value problems (IVPs) for stiff systems of ordinary differential equations (ODEs). In a recent performance evaluation of various IVP solvers, including a variable-order implementation of the MEBDF method by Cash, it turned out that the MEBDF code often performs more efficiently than codes like RADAUS, DASSL and VODE. This motivated us to look at possible parallel implementations of the MEBDF method. Each MEBDF step essentially consists of successively

solving three nonlinear systems by means of modified Newton iteration using the same Jacabian matrix. In a direct implementation of the MEBDF method of a parallel computer system, the only scope for (coarse grain) parallelism consists of a number of parallel vector updates. However, all forward-backward substitutions and all righthand side evaluations have to be done in sequence. In this paper, our starting point is the original (unmodified) EBDF method. As a consequence, two different Jacobian-evaluation and the LU-decomposition costs are not increased.
NTIS
*Backward Differencing; Boundary Value Problems; Parallel Processing (Computers); Iterative Solution*

**20020018140** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Control System Segmentation**
White, K. S.; Bickley, M.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783618; JLAB-ACE-01-06; DOE/ER/40150-1871; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Over the past seven years, the Jefferson Lab's control system has grown to include more than two hundred distributed computers running over a complex segmented network, controlling a number of semi-independent operational plants. Several of the plants, including that used for running beam for physics users, operate around the clock with only brief, scheduled interruptions for machine repairs. Because of this, high control system availability is critical. Dividing computing resources into distinct sections, called fiefdoms, improves availability of the control system for each plant while facilitating periodic maintenance. In order to maximize uptime, each fiefdom operates as a completely independent control system consisting of a file server machine with a complete set of control system software and files, a local network, operator consoles and computers to execute high and low level control programs. The fiefdoms are isolated using network hardware, while still allowing limited communication between them. by segmenting the control system in this manner, the effect of a computer failure is minimized and machines can be taken down for periodic maintenance and upgrades without disabling other controls capabilities for the site.
NTIS
*Computer Systems Performance; Particle Accelerators; Control Systems Design; Distributed Processing*

**20020018513** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Paralle Adams Methods. Modelling, Analysis and Simulation**
van der Houwen, P. J.; Messina, E.; Jul. 1998; 22p; In English
Report No.(s): PB2001-108514; MAS-R9810; Copyright; Avail: National Technical Information Service (NTIS), Microfiche
The purpose of this paper is the design of a class of parallel methods for solving nonstiff IVPs. We shall construct explicit methods of order k+1 with k parallel stage where each stage equation is of Adams-Bashforth type and implicit methods of order k+2 with k parallel stages which are of Adams-Moulton type. The abcissae in both families of methods are proved to be the Lobatto points, so that the Adams-Bashforth type method can be used as a predictor for the Adams-Moulton type corrector.
NTIS
*Parallel Programming; Parallel Processing (Computers); Simulation*

**20020018615** Naval Postgraduate School, Monterey, CA USA
**Design and Implementation of Online Communities**
Del Grosso, Michael; Sep. 2001; 109p; In English
Report No.(s): AD-A397008; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
There are many claims that building an online community on the Internet is the next big thing for online businesses to enhance their bottom line. Advertising has been the biggest moneymaker on the Internet so far so attention is money on today's Internet. The idea of an online community is to build communication tools into a website to allow visitors to interact with each other and encourage them to return often. by providing visitors with a place to interact with others and talk about their interests companies can better target them with advertising. Certainly a web site that brings users back over and over again is very appealing to any organization that is trying to sell goods or get their message heard, But the building of an online community is not as simple as just adding discussion forums and/or chat rooms to a web site, In fact, many believe that a successful community is only 10% dependent upon technology and 90% dependent upon people, This thesis takes a look at the principles of successful online communities according to current literature and then analyzes the application of these principles on some popular online communities It then takes a detailed look at PRESENCE-Lite, an online community built by the author based on the principles of online communities.
DTIC
*On-Line Systems; Client Server Systems; Commerce; Marketing*

**20020019147** Academy of Sciences (Russia), Inst. of Information Science and Automation, Saint Petersburg, Russia

**Information Assurance in Computer Networks: Methods, Models and Architectures for Network Security**

Gorodetski, Vladimir I., Editor; Skormin, Victor A., Editor; Popyack, Leonard J., Editor; May 2001; 322p; In English; Proceedings of Intl. Workshop on Mathematical Methods, Models and Architecture for Network Security Systems, St. Petersburg, Russia, 21-23 May 2001

Report No.(s): AD-A396962; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

This volume contains the papers selected for presentation at the International Workshop on Mathematical Methods, Models and Architectures for Network Security Systems (MMM-ACNS 2001) held in St. Petersburg, Russia on May 21-23, 2001. The workshop was organized by the St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences (SPIIRAS) in cooperation with the Russian Foundation for Basic Research (RFBR), the U.S. Air Force Research Laboratory and the U.S. Air Force Office of Scientific Research. The workshop focus was on mathematical aspects of information and computer network security and the role of mathematical issues in contemporary and future development of models of secure computing. Topics included: mathematical models for computer networks and applied system security; methods and models for intrusion detection; mathematical basis and applied techniques of cryptography and steganography; applied techniques of cryptography and models for access control, authentication and authorization.

DTIC

*Conferences; Mathematical Models; Computer Networks; Computer Information Security*

**20020019554** California Univ., Radiation Lab., Livermore, CA USA

**Distributed Denial of Service: Trin00, Tribe Flood Network, Tribe Flood Network 2000, and Stacheldraht CIAC-2319**

Criscuolo, Paul J.; Feb. 14, 2000; 19p; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): AD-A396999; CIAC-2319; UCRL-ID-136939 REV.1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One type of attack on computer systems is known as a Denial of Service (DoS) attack. A Denial of Service attack is designed to prevent legitimate users from using a system. Traditional Denial of Service attacks are done by exploiting a buffer overflow, exhausting system resources, or exploiting a system bug that results in a system that is no longer functional. In the summer of 1999, a new breed of attack has been developed called Distributed Denial of Service (DDoS) attack. Several educational and high capacity commercial sites have been affected by these Distributed Denial of Service attacks. A Distributed Denial of Service attack uses multiple machines operating in concert to attack a network or site. There is very little that can be done if you are the target of a DDoS. The nature of these attacks cause so much extra network traffic that it is difficult for legitimate traffic to reach your site while blocking the forged attacking

DTIC

*Computer Information Security; Electronic Warfare; Access Control*

**20020020971** Naval Postgraduate School, Monterey, CA USA

**Using Network Management Systems to Detect Distributed Denial of Service Attacks**

Negi, Chandan Singh; Sep. 2001; 137p; In English

Report No.(s): AD-A397257; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Distributed Denial of Service (DDoS) Attacks have been increasingly found to be affecting the normal functioning of organizations causing billions of dollars of losses. Organizations are trying their best to minimize their losses from these systems. However, most of the organizations widely use the Network Management Systems (NMS) to observe and manage their networks. One of the major functional areas of a NMS is Security Management. This thesis examines how the Network Management Systems could aid in the detection of the DDoS attacks so that the losses from these could be minimized. The thesis details the SNMP (simple network management protocol) MIB (Management Information Base) variables of importance for detecting these attacks and the MIB signatures of the specific attack.

DTIC

*Electronic Warfare; Computer Information Security; Management Systems; Data Management*

## 63
## CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

*Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also 54 Man/System Technology and Life Support.*

**20020016145** Alabama Univ., Dept. of Electrical and Computer Engineering, Huntsville, AL USA
**Smooth Sliding Mode Controller Design for Robust Missile Autopilot**
Shtessel, Yuri B.; Sep. 2001; 32p; In English
Contract(s)/Grant(s): DAAH01-01-C-R160
Report No.(s): AD-A396800; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presented is a method of smooth sliding mode control design to provide for the second-order sliding mode on the selected sliding surface. The control law is a nonlinear dynamic feedback that in absence of unknown disturbances provides for finite-time convergence of the second-order reaching phase dynamics. The application of the second-order disturbance observer in a combination with the proposed continuous control law gives the second-order sliding accuracy in presence of unknown disturbances and the discrete-time control update. The piecewise constant control feedback is smooth. The proposed control scheme is applied to a generic three-loop control system, and the proposed multiple time scale sliding mode design is demonstrated on the simplified model of a ballistic interceptor missile.

DTIC
*Automatic Pilots; Ballistic Missiles; Algorithms; Control Systems Design; Robustness (Mathematics); Sliding*

**20020016482** Army Communications-Electronics Command, Fort Monmouth, NJ USA
**Metaknowledge Supporting Battlespace Planning, Execution Monitoring and Replanning**
Powell, Gerald M.; June 2001; 13p; In English; 6th; International Command and Control Research and Technology Symposium, 19-21 June 2001, Annapolis, MD, USA
Report No.(s): AD-A396779; CECOM-TR-01-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In its broadest sense, battlespace planning is arguably the central element of military command and control. A major objective of this paper is to promote the development of a clearer understanding of the computational issues associated with battlespace planning and thereby more appropriately focus research on human expertise with respect to these types of problems and clarify the kind of computational studies of planning needed to design and build planning systems of this kind. This paper describes how the set of conditions assumed to hold in the standard Al planning paradigm are violated in battlespace planning. A set of characteristics about the nature of battlespace planning are identified, and a set of assumptions about capabilities required to adequately address these characteristics is provided. Suggestions are made regarding the kinds of knowledge that are needed to achieve these capabilities. Examples employing nominal battlespace scenarios are provided to illustrate the characteristics and capabilities and to highlight the importance of these knowledge types and show how they can be used. The likely sources of these Knowledge types and possible ways to collect or develop them as well as how the utility of this knowledge can be evaluated is briefly described.

DTIC
*Command and Control; Military Operations; Mission Planning; Artificial Intelligence*

**20020016698** Brookhaven National Lab., Upton, NY USA
**Injection painting optimization with fuzzy logic expert system**
Beebe-Wang,; Tang,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783981; BNL-68096; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Optimizing transverse particle distributions in the accumulator ring is one of most important factors to the future performance of the Spallation Neutron Source (SNS). This can only be achieved by optimizing the injection bumps that paint the beam in phase space. The process is complex due to the vague distribution inputs and the multiple optimization goals. Furthermore, the priority of the optimization criteria could change at different operational stages. We propose optimizing transverse phase space painting with fuzzy logic and present our initial studies toward that end. The focus of this paper is on how the problem can be solved with a Fuzzy Logic (FL) expert system through the creation of a set of rules that can be applied by the system. Various particle distributions, from computer simulations, are analyzed with FL and the results are compared and discussed. Finally, a run-time optimization control system is proposed.

NTIS
*Expert Systems; Beam Injection; Fuzzy Systems; Storage Rings (Particle Accelerators)*

**20020017464** University of Southern Mississippi, Hattiesburg, MS USA
**Neural Network Based Hyperspectral Algorithms** ***Final Report, Jan. 1999-Mar. 2001***
Rayborn, Grayson H.; Holyer, Ronald J.; Nov. 14, 2001; 21p; In English
Contract(s)/Grant(s): N00014-99-1-0210; Proj-01PR00410-00
Report No.(s): AD-A396801; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In ocean optics the forward problem is solved and several computer implementations of in-water radiative transfer are available. Using these radiative transfer models, water-leaving radiance can be calculated with precision limited only by the availability of computer resources. However, the inverse problem (i.e., given observations of water-leaving radiance, find the water and illumination conditions that necessarily lead to this observation) is not solved in closed analytical form. The inverse relationship may even be many-to-one. Moreover solution of the inverse problem is the essence of remote sensing, where the objective is retrieval of water depth, water inherent optical properties, bottom reflectance, or some other parameter from observations of water-leaving spectral radiance or reflectance. In lieu of nitrous inversion, various empirical, semianalytical, statistical, or numerical methods have been utilized for retrieval of ocean parameters from remotely sensed spectral radiance data. We use a neural network to numerically model the inverse problem based on a synthetic data set produced by a radiative transfer model. This paper shows the result of that procedure applied to retrieval of water depth from hyperspectral imagery of the Ship Island area off the coast of Mississippi.
Derived from text
*Algorithms; Neural Nets; Oceans; Radiative Transfer; Underwater Optics; Numerical Analysis*

**20020018616** Universite de Corse, Inst. of Scientific Studies of Cargese, Corte, France
**QUICK: Quantum Interference and Cryptographic Keys: Novel Physics and Advancing Technologies**
Grangier, Philippe; Rarity, John; Karlsson, Anders; Apr. 13, 2001; 108p; In English, 7-13 Apr. 2001, Corsica, France
Contract(s)/Grant(s): N68-71-01-M-5350
Report No.(s): AD-A396898; R/D-9073-PH-02; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The goal of this conference is to provide a forum for scientific exchanges for one hundred researchers and students, from academia and industry, working world-wide on the physics, implementations, and applications of quantum communications.
Derived from text
*Conferences; Cryptography; Quantum Theory*

**20020018824** Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
**Coevolution of Finite State Agents** ***Coevolucao de Agentes de Estado Finito***
PereiraPessoa, Marcus Vinicius, Instituto Nacional de Pesquisas Espacias, Brazil; [2001]; 190p; In Portuguese
Report No.(s): INPE-8488-TDI/780; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This work is concerned with the study of evolutionary algorithms to find solutions of problems involving coevolution of agents, whose behavior correspond to finite state machines. The genetic algorithms are the based on the coevolution process, approaching cooperative and competitive behaviors. The cooperation happens within a specific group of agents and the competition happens among these groups. For this study several genetic algorithms' characteristics were varied where the interactions among the agents happen. Factors, such as the representation and control of the population's elements, were controlled by the genetic algorithm. The algorithm's selection and operation were explored to evaluate which aspects would be more convenient for applications in those types of problems. For the completion of this work, the Swarm simulation system, developed by Santa Fe Institute, USA, was used.
Author
*Genetic Algorithms; Problem Solving*

**20020018900** Hampton Univ., Dept. of Physics, VA USA
**Virtual Instrumentation for a Fiber-Optics-Based Artificial Nerve**
Lyons, Donald R., Hampton Univ., USA; Kyaw, Thet Mon, Hampton Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 27; In English; Also announced as 20020018881
Report No.(s): P19; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A LabView-based computer interface for fiber-optic artificial nerves has been devised as a Masters thesis project. This project involves the use of outputs from wavelength multiplexed optical fiber sensors (artificial nerves), which are capable of producing dense optical data outputs for physical measurements. The potential advantages of using optical fiber sensors for sensory function restoration is the fact that well defined WDM-modulated signals can be transmitted to and from the sensing region allowing networked units to replace low-level nerve functions for persons desirous of "intelligent artificial limbs." Various FO sensors can

be designed with high sensitivity and the ability to be interfaced with a wide range of devices including miniature shielded electrical conversion units. Our Virtual Instrument (VI) interface software package was developed using LabView's "Laboratory Virtual Instrument Engineering Workbench" package. The virtual instrument has been configured to arrange and encode the data to develop an intelligent response in the form of encoded digitized signal outputs. The architectural layout of our nervous system is such that different touch stimuli from different artificial fiber-optic nerve points correspond to gratings of a distinct resonant wavelength and physical location along the optical fiber. Thus, when an automated, tunable diode laser sends scans, the wavelength spectrum of the artificial nerve, it triggers responses that are encoded with different touch stimuli by way wavelength shifts in the reflected Bragg resonances. The reflected light is detected and a resulting analog signal is fed into ADC1 board and DAQ card. Finally, the software has been written such that the experimenter is able to set the response range during data acquisition.

Author

*Virtual Reality; Fiber Optics; Human-Computer Interface; Optical Fibers; Nervous System; Artificial Intelligence*

**20020019069** Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA

**Neural Network Based Adaptive Control of Uncertain and Unknown Nonlinear Systems** ***Final Report, 1 Dec. 2000-30 Nov. 2001***

Calise, Anthony J.; Sep. 01, 2001; 8p; In English

Contract(s)/Grant(s): F49620-01-1-0024

Report No.(s): AD-A396974; E-16-T11; AFRL-SR-BL-TR-01-0605; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Our main accomplishment this past year has been to finalize and apply two approaches to output feedback adaptive control. The first is a direct adaptive approach, while the second uses a new error state observe. Both approaches overcome the limitation of earlier adaptive state observer based methods, which require that the order of the plant be known, and impose severe restrictions on the relative degree of regulated output variables. Within this context, we also have continued to exploit our approach for adaptive hedging of actuator limits, which was the highlight of last year's report. We have also made some progress in the area of decentralized adaptive control. Our most significant interactions have been with NASA Marshall, NASA Ames, Wright Patterson AFB, Eglin AFB, Boeing and Lockheed.

DTIC

*Feedback Control; Adaptive Control; Neural Nets*

**20020019070** Connecticut Univ., Dept. of Electrical and Systems Engineering, Storrs, CT USA

**Estimation with Multisensor-Multiscan Detection Fusion** ***Final Report, 1 Apr. 1997-30 Nov. 1999***

Bar-Shalom, Yaakov; Jun. 06, 2000; 10p; In English

Contract(s)/Grant(s): F49620-97-1-0198

Report No.(s): AD-A396961; AFRL-SR-BL-TR-01-0610; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The research effort reported here focused on the development, of practical advanced algorithms for optimal processing of the information obtained from various remote sensing devices for surveillance and tracking targets. The processing consists of integration/filtering of the sensor data across time and fusion across sensors with the main goal being overcoming the inherent limitation of real-world sensors (accuracy and reliability) due to noise - which cause false alarms - and other factors, such as low observable (LO) targets - which lead to low detection probability. We developed algorithms for: association and fusion of measurements from multiple, asynchronous heterogeneous sensors based on discrete mathematical optimization techniques (multidimensional matching techniques) for practical high density scenarios, target tracking for the case of glint and multipath; ground target tracking in a Joint STARS scenario; phased array radar resource allocation; track formation of LO targets from EO sensor data; parallelization of assignment algorithms; segmentation of images of targets overlapping in the focal plane and their tracking; radar waveform design for optimized tracking performance; estimation of trajectory parameters for TBM in boost phase; track before detect approach for VLO targets with fluctuating amplitude: passive ranging of LO TBM; unbiased conversion of polar and spherical coordinate radar measurements to Cartesian for long range radars: generalization of the CRLB in the presence of false measurements to non-Gaussian distribution; an efficient estimator for acquisition by an ESA radar of a LO TBM prior to reentry; a Fokker-Planck-Kolmogorov equation based estimator for highly nonlinear systems with large noises; a variable bandwidth estimator for EAW scenarios.

DTIC

*Target Recognition; Multisensor Fusion; Sonar; Targets*

**20020019814** Naval Postgraduate School, Monterey, CA USA
**Designing Realistic Human Behavior into Multi-Agent Systems**
Hennings, Chad F.; Sep. 2001; 76p; In English; Original contains color images
Report No.(s): AD-A397090; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

As Multi-agent systems advance toward moving virtual humans such as modeled infantry soldiers around a virtual environment for modeling and simulation purposes, an important factor to be considered is how the agent internalizes and reacts to its environment. One method to simulate this sensory perception and the construction of generalized internal knowledge is the symbolic reactive agent architecture. This architecture utilizes symbolic constructive agents to internalize and symbolically represent the outside environment within the agent and reactive agents to decide what course of action will be taken next based on this internal environment. This type of architecture also lends itself well to putting variability and non-homogeneity into different agents by controlling the level of hindrance or interference that the agent utilizes when constructing this inner environment. A simple path finding task was used to determine the overall utility of this architecture with respect to truly representing human performance in cognitive tasks. Humans as well as different simulated agents were put through the same task in their respective environment and their results were compared. A concept called the bracketing heuristic was also utilized to determine whether the model may translate well to general path-finding tasks.
DTIC
*Computerized Simulation; Human Behavior; Mental Performance; Sensory Perception*

**20020020424** Chien Kao Inst. of Tech., Dept. of Electrical Engineering, Changhua, Taiwan, Province of China
**Robust Stabilization of Parameter Perturbed Systems with Delayed States and Control Delay**
Liu, Pin-Lin, Chien Kao Inst. of Tech., Taiwan, Province of China; Kang, Tze-Li, National Changhua Univ. of Education, Taiwan; Su, Te-Jen, National Kaoshiung Univ. of Applied Science, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; November 2001; ISSN 0253-3839; Volume 24, No. 6, pp. 781-789; In English; Copyright; Avail: Issuing Activity

The paper concerns the issue of robust stabilization for parameter perturbed time delay systems in which delay terms appear as both states and controls. The uncertain time delay systems under consideration are described by state differential equations with time-varying unknowns but bounded uncertain parameters. Based on the Lyapunov-Krasovskii functional techniques, robust exponential stability criteria are derived. The results depend on the size of delays and are given in terms of several linear matrix inequalities (LMIs), The results have been illustrated by given numerical examples. We believe that the proposed schemes are applicable to robust control design.
Author
*Inequalities; Robustness (Mathematics); Time Lag; Perturbation Theory; Control Systems Design*

**20020020443** National Taiwan Univ., Dept. of Electrical Engineering, Taipei, Taiwan, Province of China
**Motion Control of a Hydraulic Stewart Platform with Computed Force Feedback**
Hsu, Chih-Chin, National Taiwan Univ., Taiwan, Province of China; Fong, I.-Fong, National Taiwan Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; November 2001; ISSN 0253-3839; Volume 24, No. 6, pp. 709-721; In English
Contract(s)/Grant(s): NSC-86-2623-D-002-025; NSC-89-2213-E-002-088; Copyright; Avail: Issuing Activity

On a Stewart platform with six hydraulic links, we mount three gyroscopes to measure the angular motion rates of its upper platform. Using these rate signals and the link lengths measured by LVDTs, we compute the orientation and position of the upper platform, as well as the static force acting on each link. These forces are put into a dynamic model of the hydraulic links based on which we determine the feedback gains for controlling the link lengths. Experiments on the platform with an unbalanced payload show that utilizing gains determined this way generates better results than utilizing a constant gain for all links.
Author
*Dynamic Models; Gyroscopes; Hydraulics; Feedback Control; Kinematics*

## 64
## NUMERICAL ANALYSIS

*Includes iteration, differential and difference equations, and numerical approximation.*

**20020016159** Naval Surface Warfare Center, Dahlgren Div., Dahlgren, VA USA
**General Solution to Constant Gain Tracking Filters**
Smith-Carroll, A.; Gray, John E.; Jun. 2001; 77p; In English
Report No.(s): AD-A396720; NSWCDD/TR-01/68; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report presents a general solution to Constant Gain Tracking Filters, which are nothing more than matrix difference equations. These equations can be solved regardless of the measurement model provided the model is deterministic. The general solution can then be used to compute the covariance matrix under very general assumptions about the noise. In this report, the general case will be solved, and the alpha-beta will be solved as an illustrative example.
DTIC
*Tracking Filters; Amplification*

**20020017473** National Defence Research Establishment, Stockholm, Sweden
**Relationship between the Compound-Matrix and Riccati Methods for Solving Boundary-Value Problems**
Ivansson, S.; Nov. 2000; 28p; In English
Report No.(s): PB2001-108426; FOA-R-00-01664-409-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Numerically difficult boundary-value problems for linear ODE systems can be solved with the compound-matrix and Riccati methods. A drawback with the compound-matrix method is that the dimensions of the ODE systems for the compound quantities can become large. Quadratic relations for these quantities are derived and used to reduce the systems dimensions. The Riccati method appears, and this method is viewed as a dimension-reduction technique in the context of the compound-matrix method. Certain singularity problems with the Riccati method are naturally handled by inclusion of an additional forward-sweep equation to allow reconstruction of all compound-vector elements. In particular, argument-variation techniques for determination of eigenvalues become applicable. For applications to underwater acoustics, the compound-matrix method is ideally suited to handle wave propagation through a layered solid isotropic bottom.
NTIS
*Boundary Value Problems; Seismic Waves; Mathematical Models; Differential Equations; Matrix Methods*

**20020017750** Sverdrup Technology, Inc., Huntsville, AL USA
**Analytical Modeling of Variable Density Multilayer Insulation for Cryogenic Storage**
Hedayat, A., Sverdrup Technology, Inc., USA; Hastings, L. J., NASA Marshall Space Flight Center, USA; Brown, T., NASA Marshall Space Flight Center, USA; [2001]; 8p; In English; Cryogenic Engineering Conference, 16-20 Jul. 2001, Madison, WI, Madison, WI, USA, USA
Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
A unique foam/Multilayer Insulation (MLI) combination concept for orbital cryogenic storage was experimentally evaluated at NASA Marshall Space Flight Center (MSFC) using the Multipurpose Hydrogen Test Bed (MHTB). The MLI was designed for an on-orbit storage period of 45 days and included several unique features such as: a variable layer density and larger but fewer perforations for venting during ascent to orbit. Test results with liquid hydrogen indicated that the MLI weight or heat leak is reduced by about half in comparison with standard MLI. The focus of this paper is on analytical modeling of the Variable Density MLI (VD-MLI) on-orbit performance (i.e. vacuum/low pressure environment). The foam/VD-MLI combination model is considered to have five segments. The first segment represents the optional foam layer. The second, third, and fourth segments represent three MLI segments with different layer densities. The last segment is considered to be a shroud that surrounds the last MLI layer. Two approaches are considered. In the first approach, the variable density MLI is modeled layer by layer while in the second approach, a semi-empirical model is applied. Both models account for thermal radiation between shields, gas conduction, and solid conduction through the layer separator materials.
Author
*Mathematical Models; Density (Mass/Volume); Multilayer Insulation; Foams*

**20020018006** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Finding Column Dependencies in Sparse Matrices over F2 by Block Wiedemann. Modeling, Analysis and Simulation**
Penninga, O.; Sep. 1998; 46p; In English
Report No.(s): PB2001-108640; MAS-R9819; Copyright; Avail: National Technical Information Service (NTIS), Microfiche
Large systems of linear equations over F2 with sparse coefficient matrices have to be solved as a part of integer factorization with sieve-based methods such as in the Number Field Sieve algorithm. In this report, the authors first discuss the Wiedmann algorithm to solve these systems and investigate the relation between the sparsity of the matrix and the performance of (a slightly adapted version of) the algorithm. Then the authors turn to the more efficient block algorithms and discuss a new version of the block Wiedmann algorithm, proposed by Villard, based on the FPHPS algorithm by Beckerman and Labahn. Finally the authors compare the performance of their implementation of this version of the algorithm with that of Lobo's implementation of the

classical block Wiedmann algorithm and that of Montgomery's implementation of his block Lanczos algorithm. The latter is shown to be much faster, even more than expected theoretically.
NTIS
*Matrices (Mathematics); Linear Equations*

**20020018040** Defence Science and Technology Organisation, Weapons Systems Div., Fishermans Bend, Australia
**Ordnance Heating Rates in Shipboard Magazines**
Doolan, Con; Jul. 2001; 44p; In English
Report No.(s): AD-A396722; DSTO-TR-1188; DODA-AR-011-953; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a numerical method of determining the heating rate to ordnance cylinders stored in a Ship's Magazine. The source of heating is assumed to be a hydrocarbon fuel fire burning in an adjacent compartment. The heat released from the fire raises the temperature of a common bulkhead which then radiates energy onto the ordnance in the magazine. The method compares well with data available in the literature for shipboard fuel fire. Based on the strength of these comparisons, the method is used to estimate the likely heating rate for the Penguin ASM while mounted within the ANZAC Air Weapons magazine.
DTIC
*Ships; Fires; Magazines (Supply Chambers)*

**20020018165** NASA Marshall Space Flight Center, Huntsville, AL USA
**Comparison of Analytical and Numerical Performance Predictions for a Regenerative Heat Exchanger in the International Space Station Node 3 Internal Active Thermal Control System**
Wise, Stephen A., Qualis Corp., USA; Holt, James M., NASA Marshall Space Flight Center, USA; [2001]; 10p; In English; Thermal and Fluids Analysis Workshop, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The complexity of International Space Station (ISS) systems modeling often necessitates the concurrence of various dissimilar, parallel analysis techniques to validate modeling. This was the case with a feasibility and performance study of the ISS Node 3 Regenerative Heat Exchanger (RHX). A thermo-hydraulic network model was created and analyzed in SINDA/FLUINT. A less complex, closed form solution of the system dynamics was created using Excel. The purpose of this paper is to provide a brief description of the modeling processes utilized, the results and benefits of each to the ISS Node 3 RHX study.
Author
*Feasibility Analysis; Finite Difference Theory; Prediction Analysis Techniques; Thermal Analysis; Models*

**20020018880** Naval Postgraduate School, Monterey, CA USA
**Implementing the Cross Ambiguity Function and Generating Geometry-Specific Signals**
Johnson, Joe J.; Sep. 2001; 123p; In English
Report No.(s): AD-A397131; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The first purpose of this thesis is to implement an efficient Cross Ambiguity Function (CAF) algorithm to compute the Time Difference of Arrival (TDOA) and Frequency Difference of Arrival (FDOA) between two sampled signals. Two CAF-related MATLAB functions were written and analyzed. One implements a 'coarse' mode and a 'fine' mode to accurately compute the TDOA and FDOA. The second plots different views of the resulting three-dimensional CAF surface. The second purpose is to develop a program to generate geometry-specific signals. Some software packages can artificially embed constant TDOAs and FDOAs between two signals. In real-world emitter-collector geometries (one emitter and two separate collectors) however movement of the emitter and/or collectors causes time-varying TDOAs and FDOAs. A MATLAB function was written to generate pairs of Binary-Phase-Shift-Keying signals according to user-defined signal parameters and Cartesian geometries. The resulting signal pairs have realistic TDOAs and FDOAs that vary with time according to geometry and relative motion. Several signal pairs with different geometrics are generated and input into the CAF functions and the results are compared with theoretical TDOA and FDOA calculations. Finally, signals with low signal-to-noise ratios are generated to evaluate the CAF's ability to find Low Probability of Detection signals.
DTIC
*Computer Programs; Algorithms; Cartesian Coordinates; Probability Theory; Accumulators; Aerosols*

**20020019416** Space and Naval Warfare Systems Center, San Diego, CA USA
**A Recursive Method for Generating the Gray Code**
Dillard, G. M.; Jan. 2000; 5p; In English
Contract(s)/Grant(s): Proj. ZU92
Report No.(s): AD-A397121; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The Gray code is a mapping of the naturally ordered B-bit binary numbers to all ordering in which the binary representations of successive integers differ by exactly one bit. For example, the 4-bit Gray code representations of 7 and 8 are 0100 and 1100, respectively, which differ by one bit. The natural representations are 0111 and 1000, which differ by three bits. The purpose of this correspondence is to present a simple recursive method for generating the Gray code.
DTIC
*Binary Codes; Bits; Arithmetic; Recursive Functions*

**20020020994** Michigan State Univ., Dept. of Mechanical Engineering, East Lansing, MI USA
**Penalty-Based Finite Element Interface Technology for Analysis of Homogeneous and Composite Structures**
Averill, Ronald C., Michigan State Univ., USA; [2002]; 66p; In English
Contract(s)/Grant(s): NAG1-2213; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An effective and robust interface element technology able to connect independently modeled finite element subdomains has been developed. This method is based on the use of penalty constraints and allows coupling of finite element models whose nodes do not coincide along their common interface. Additionally, the present formulation leads to a computational approach that is very efficient and completely compatible with existing commercial software. A significant effort has been directed toward identifying those model characteristics (element geometric properties, material properties, and loads) that most strongly affect the required penalty parameter, and subsequently to developing simple 'formulae' for automatically calculating the proper penalty parameter for each interface constraint. This task is especially critical in composite materials and structures, where adjacent sub-regions may be composed of significantly different materials or laminates. This approach has been validated by investigating a variety of two-dimensional problems, including composite laminates.
Author
*Finite Element Method; Composite Structures; Computerized Simulation; Interfaces*

## 65
## STATISTICS AND PROBABILITY

*Includes data sampling and smoothing; Monte Carlo method; time series and analysis; and stochastic processes.*

**20020019955** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Random Sampling for the Monomer-Dimer Model on a Lattice. Probability, Networks and Algorithms**
van den Berg, J.; Brouwer, R.; Dec. 1999; 20p; In English
Report No.(s): PB2002-101673; CWI-PNA-R9917; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

In the monomer-dimer model on a graph, each matching (collection of non-overlapping edges) M has a probability proportional to lambda, where lambda greater than 0 is the model parameter, and (M) denotes the number of edges in M. An approximate random sample from the monomer-dimer distribution can be obtained by running an appropriate Markov chain (each step of which involves an elementary local change in the configuration) sufficiently long.
NTIS
*Random Sampling; Probability Theory; Markov Chains*

**20020019956** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Consistent Estimation of the Intensity Function of a Cyclic Poisson Process. Probability, Networks and Algorithms**
Helmers, R.; Mangku, I. W.; Zitikis, R.; Dec. 31, 1999; 22p; In English
Report No.(s): PB2002-101671; CWI-PNA-R9915; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

We construct and investigate a consistent kernel-type nonparametric estimator of the intensity function of a cyclic Poisson process when the period is unknown. We assume that only a single realization of the Poisson process is observed in a bounded

window. In particular, we prove that the proposed estimator is weakly and strongly consistent when the size of the window expands.
NTIS
*Kernel Functions; Poisson Density Functions; Probability Theory; Stochastic Processes*

**20020019957** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Nearest Neighbor Estimation of the Intensity Function of a Cyclic Poisson Process. Probability, Networks and Algorithms**
Mangku, I. W.; Dec. 1999; 16p; In English
Report No.(s): PB2002-101670; CWI-PNA-R9914; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

We consider the problem of estimating the intensity function of a cyclic Poisson point process. We suppose that only a single realization of the cyclic Poisson point process is observed with a bounded 'window,' and our aim is to estimate consistently the intensity function at a given point. A nearest neighbor estimator of the intensity function is proposed, and we show that our estimator is weakly and strong consistent, as the window expands.
NTIS
*Probability Theory; Poisson Density Functions; Stochastic Processes*

**20020019958** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Note on Bernstein-Type Inequalities for Martingales. Probability, Networks and Algorithms**
Dzhaparidize, K. O.; vanZanten, J. H.; Nov. 1999; 16p; In English
Report No.(s): PB2002-101669; CWI-PNA-R9912; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Several inequalities of Bernstein's type are derived in a unified manner. Some extra light is shed on the classical inequalities and implications are sought for instance for conditionally symmetric martingales and sequences of asymptotically continuous martingales.
NTIS
*Martingales; Inequalities; Continuity (Mathematics); Asymptotic Properties*

**20020019959** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Statistical Estimation of Poisson Intensity Functions. Probability, Networks and Algorithms**
Helmers, R.; Mangku, I. W.; Dec. 1999; 18p; In English
Report No.(s): PB2002-101668; CWI-PNA-R9913; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

This survey paper is concerned with nonparametric estimation of the global and local intensity of a cyclic Poisson point process X. We assume that only a single realization of X is observed, though only within a bounded 'window,' and our aim is to estimate consistently the global intensity and the intensity function at a given point. A simple nonparametric estimator for the global intensity is proposed and studied. We also give a preview of recent work by the present authors, in part joint with R. Zitikis (Winnipeg), on nonparametric estimation of the local intensity at a given point. These results will also be contained in I.W. Mangku's forthcoming Ph.D. thesis.
NTIS
*Poisson Density Functions; Statistical Analysis; Probability Theory*

## 66
## SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

*Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.*

**20020016348** Defence Research Establishment Ottawa, Ottawa, Ontario Canada
**Netcentric Warfare for Dynamic Coalitions: Implications for Secure Interoperability**
McIntyre, Mark, Defence Research Establishment Ottawa, Canada; Flemming, Sherri, Defence Research Establishment Ottawa, Canada; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 21-1 - 21-12; In English; Also announced as 20020016329; Original contains color illuatrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The term network centric, or netcentric, warfare is commonly used in military literature to connote the future of military operations where timely and ubiquitous sharing of information among operational forces will lead to dramatic improvements in mission effectiveness. If this mode of operation is to be successfully employed in coalition operations, then particular attention must be paid to secure interchange of information among the coalition partners. In this paper, various modes of netcentric warfare are discussed and the implications of introducing information security at various levels are presented. In particular, the network quality-of-service requirements for the different netcentric modes are discussed with emphasis on the trade-offs that must be made when information security is an important consideration.
Author
*Interoperability; Military Operations; International Cooperation; Information Systems*

**20020016352** Ministry of Defence, London, UK
**Coalition Requirements for Shared Situational Awareness**
Stewart, James, Ministry of Defence, UK; Pierre, Leslie, Ballistic Missile Defense Organization, USA; Harrison, Clive, Defence Scientific Technology Lab., UK; Collinson, Alan, Collinson Systems Ltd., UK; Evans, Gordon, Vanguard Research, Inc., USA; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 25-1 - 25-6; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The U.S. Ballistic Missile Defense Organization (BMDO) and the UK Ministry of Defence, Directorate of Science (Ballistic Missile Defence) (MOD DSc(BMD)) have undertaken a series of three bilateral Policy-Military Seminars focusing on Theater Ballistic Missiles (TBM). Two additional seminars are being planned. This presentation describes the challenges that are the basis of these seminars, how they are conducted, their most important findings and, in particular, what these seminars have taught the sponsors about the requirements for shared situational awareness which, ultimately, forms the context to interpret the common operating picture.
Author
*Ballistic Missiles; Missile Defense; International Cooperation; Interoperability; Situational Awareness*

**20020018608** Army Command and General Staff Coll., Fort Leavenworth, KS USA
**Manned, Fixed-Wing Aviation: Should It Continue to Conduct the Preplanned Interdiction Mission**
Mackenzie, Timothy J.; Jun. 01, 2001; 99p; In English; Original contains color images
Report No.(s): AD-A397024; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Manned flight has been integral to the fight on the battlefield since World War I. World War II was the first large-scale showcase for aviation in the interdiction role while the Vietnam War heralded the advent of precision-guided munitions. During Operation DESERT STORM, the interdiction mission, once almost exclusively conducted by manned aviation, had to share the mission with new weapon systems. This trend in technological evolution brings about the question, As military technological advancements evolve toward Joint Vision 2020, should manned, fixed-wing aviation continue to conduct the preplanned interdiction mission? The design for this project revolves around a comparative assessment model of weapon systems that can accomplish the preplanned interdiction mission. The performance results of the selected weapon systems across interdiction relevant categories provide the framework for this analysis. The determination from this study is that manned, fixed-wing aviation should expect to be phased out of the preplanned interdiction mission over the next 20 years. This phase out process began in 1991 during Operation DESERT STORM with the introduction of cruise missiles. The process will begin to reach completion with the maturity of UCAVs in about 2010. UCAVs and missiles will become the principal elements of the U.S. military s preplanned interdiction effort.
DTIC
*Military Operations; Fixed Wings*

**20020019355** Illinois Univ., Dept. of General Engineering, Urbana, IL USA
**The Design, Implementation, Application, and Dissemination of an Evolving Expression-Linkage Genetic Algorithms *Final Report, 15 Feb. 1997-29 Nov. 1999***
Goldberg, David E.; Mar. 2000; 19p; In English
Contract(s)/Grant(s): F49620-97-1-0050
Report No.(s): AD-A396977; ILLIGAL-X0007; AFRL-SR-BL-TR-01-0609; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

AFOSR Grant No. F49620-97-I-0050 (Evolving Expression-Linkage GA) has come to a close and this report details project accomplishments. Particularly notable was the invention of a new competent GA, the Bayesian Optimization Algorithm (BOA) that works by budding and using a probabilistic model of the best solution points seen so far. BOA scales well and solves very

hard problems quickly reliably and accurately. Another notable achievement was the completion of a Erick Cantu-Paz's magisterial PhD dissertation entitled 'Designing Efficient and Accurate Parallel Genetic Algorithms'. This thesis provides the first scaling laws that show why GAs are so easy to make parallel and how to do it better. These findings and accomplishments are discussed in the final project report together with others, including the development of a new theory of hybrid optimization and a new theory of effective lime utilization. The report also details the affiliation and support of 26 researchers with the project, the publication, acceptance, or submission of 65 publications acknowledging AFOSR support, and numerous interactions and transitions.
DTIC
*Genetic Algorithms; Problem Solving; Bayes Theorem*

**20020020967** Army War Coll., Strategic Studies Inst., Carlisle Barracks, PA USA
**Rapid Decisive Operations: An Assumptions-Based Critique**
Echevarria, Antulio J., II; Nov. 2001; 30p; In English
Report No.(s): AD-A397272; ISBN 1-58487-073-7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
In support of the Joint community's efforts to develop a viable operational concept, the author argues that the Rapid Decisive Operations (RDO) concept's developers deserve high praise for attempting to link two relative properties, speed and decisiveness, but that the definition of RDO is at present incoherent and based on several deeply flawed assumptions. The author concludes that RDO creates dubious expectations and will likely fail to balance the strengths and weaknesses introduced by new technologies. He further recommends a method for identifying and addressing an operational concept's critical assumptions.
DTIC
*Command and Control; Operations Research; Military Operations*

## 67
## THEORETICAL MATHEMATICS

*Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.*

**20020018010** Center for Mathematics and Computer Science, Amsterdam Netherlands
**Recent Problems from Uniform Asymptotic Analysis of Integrals in Particular in Connection with Tricomi's Psi Function. Modelling, Analysis and Simulation**
Temme, N. M.; Jan. 1998; 40p; In English
Report No.(s): PB2001-108506; MAS-R9802; Copyright; Avail: National Technical Information Service (NTIS), Microfiche
The paper discusses asymptotic methods for integrals, in particular uniform approximations. We discuss several examples, where we apply the results to Tricomi's psi-function, in particular we consider an expansion of Tricomi-Carlitz polynomials in terms of hermite polynomials. We mention other recent expansions for orthogonal polynomials that do not satisfy a differential equation, and for which methods based on integral representations produce powerful uniform asymptotic expansions.
NTIS
*Integral Calculus; Asymptotic Methods; Asymptotic Series; Differential Equations*

**20020020466** Bergen Univ., Dept. of Applied Mathematics, Norway
**A Strongly Degenerate Convection-Diffusion Problem Modeling Centrifugation of Flocculated Suspensions**
Buerger, Raimund; Karlsen, Kenneth H.; Jun. 2000; 12p; In English
Report No.(s): AD-A397140; TR-147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We prove existence and uniqueness of boundary value (BV) entropy solutions of a strongly degenerate convection-diffusion problem modeling centrifugation of flocculated suspensions. A modification of the generalized upwind method is employed to solve the initial-boundary value problem numerically, i.e., to simulate the centrifugation process.
DTIC
*Boundary Value Problems; Centrifuging; Degeneration; Diffusion Theory; Convection*

## 70
## PHYSICS (GENERAL)

*Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see categories 71 through 77. For related instrumentation see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.*

**20020016100** Fermi National Accelerator Lab., Batavia, IL USA
**Search for Leptoquark Pairs Decaying to nu nu + Jets in p pbar Collisions at (radical)s = 1.8 TeV**
Abazov, V. M.; Oct. 03, 2001; 11p; In English
Report No.(s): DE2001-787317; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
No abstract prepared.
NTIS
*Leptons; Particle Decay; Proton-Antiproton Interactions; Quarks*

**20020016102** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Energy Recovery Linac (ERL) as a Driver for X-ray Producing Insertion Devices**
Tigner, M.; Bazarov, I.; Bilderback, D.; Gruner, S.; Padamsee, H.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-787355; JLAB-ACC-01-22; DOE/ER/40150-1914; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Storage rings have served well as x-ray sources, achieving continued increases in flux and brightness. While further improvements in performance may still be expected, the performance of these machines is circumscribed by radiation fluctuations and by the Touschek effect. The practical effect of the radiation fluctuations is to limit the minimum 6D emittance of the rings in general, particularly the bunch length. Through limiting the lifetime, the Touschek effect also limits the charge density in the bunches. These effects can be greatly ameliorated through use of a linac driver for the x-ray producing devices such as small gap undulators because the beam passes through only once and in a time short compared to the radiation equilibration time. In this case, the emittance is limited only by the source and the beam is thrown away after each pass so that radiation and collision effects are no longer relevant. By recovering the kinetic energy carried by the beam through use of the energy recovery principle in a superconducting linac, one can in principle support beam currents comparable to those of storage rings but with smaller emitting source area. These advantages permit the achieving of superior brilliance while giving great flexibility in bunch pattern and bunch length. The concept of a 5 - 7 GeV facility using this principle is described and parameter goals are given.
NTIS
*Linear Accelerators; Superconducting Magnets; X Ray Sources; Kinetic Energy; Storage Rings (Particle Accelerators)*

**20020016104** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Linac Optics for Energy Recovery Linac**
Bazarov, I.; Krafft, G.; Merminga, L.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-787356; JLAB-ACC-01-23; DOE/ER/40150-1915; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Several possible scenarios of Energy Recovery Linac (ERL) beam optics design are investigated to support the low emittance high current CW electron beam needed to drive a new ERL based X-ray Source. It is shown by numerical simulations that sufficiently high multipass beam break-up (BBU) threshold current can be achieved in a straightforward one-pass one-linac ERL scenario. A simple guideline for choosing optimal linac and recirculating transport line optics is suggested to realize best possible BBU threshold current.
NTIS
*Linear Accelerators; Threshold Currents; Energy Technology; Electron Beams; Optical Properties*

**20020016182** Fermi National Accelerator Lab., Batavia, IL USA
**Sleuth: A quasi-model-independent search strategy for new physics**
Knuteson, B. O.; Oct. 03, 2001; 4p; In English
Report No.(s): DE2001-787307; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
How can we search for new physics when we only vaguely know what it should look like. How can we perform an unbiased yet data-driven search. If we see apparently anomalous events in our data, how can we quantify their 'interestingness' a posteriori.

We present an analysis strategy (SLEUTH) that simultaneously addresses each of these questions, and we demonstrate its application to over thirty exclusive final states in data collected by D0 in Run I of the Fermilab Tevatron.
NTIS
*Particle Accelerators; High Energy Interactions; Elementary Particles; Theoretical Physics*

**20020016183** Fermi National Accelerator Lab., Batavia, IL USA
**Report of the Working Group on precision measurements**
Brock, R. L.; Oct. 03, 2001; 38p; In English
Report No.(s): DE2001-787296; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Precision measurements of electroweak quantities are carried out to test the Standard Model (SM). In particular, measurements of the top quark mass, m(sub top), when combined with precise measurements of the W mass, M(sub W), and the weak mixing angle, sin(sup 2) (bar (theta))(sub W), make it possible to derive indirect constraints on the Higgs boson mass, M(sub H), via top quark and Higgs boson electroweak radiative corrections to M(sub W). Comparison of these constraints on M(sub H) with the mass obtained from direct observation of the Higgs boson in future collider experiments will be an important test of the SM. In this report, the prospects for measuring the W parameters (mass and width) and the weak mixing angle in Run II are discussed, and a program for extracting the probability distribution function of M(sub H) is described.
NTIS
*Electroweak Interactions (Field Theory); Precision; Quarks; Probability Distribution Functions*

**20020016184** Fermi National Accelerator Lab., Batavia, IL USA
**Advanced Analysis Methods in High Energy Physics**
Bhat, P. C.; Oct. 03, 2001; 9p; In English
Report No.(s): DE2001-787295; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
During the coming decade, high energy physics experiments at the Fermilab Tevatron and around the globe will use very sophisticated equipment to record unprecedented amounts of data in the hope of making major discoveries that may unravel some of Nature's deepest mysteries. The discovery of the Higgs boson and signals of new physics may be around the corner. The use of advanced analysis techniques will be crucial in achieving these goals. The author discusses some of the novel methods of analysis that could prove to be particularly valuable for finding evidence of any new physics, for improving precision measurements and for exploring parameter spaces of theoretical models.
NTIS
*High Energy Interactions; Mathematical Models; Standard Model (Particle Physics); Elementary Particles*

**20020016185** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Lorentz transmission electron microscopy investigation of magnetically patterned Co/Pt multilayers**
Kusinski, G. J.; Krishnan, K. M.; Weller, D.; Terris, B. D.; Folks, L.; Aug. 01, 2000; 5p; In English
Report No.(s): DE2001-787273; LBNL-46721; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The switching behavior of magnetic patterns prepared by ion irradiation was investigated. Co/Pt multilayers with perpendicular anisotropy and large out-of-plane coercivities 5-6 kOe were grown on electron transparent SiN windows. Regularly spaced 1 micron sized regions, were magnetically pattered via ion beam irradiation through a stencil mask. Lorentz TEM was used to observe in-situ magnetization reversal processes of irradiated regions under well-defined applied magnetic fields. When the in-plane field was increased, domain wall motion was observed, resulting in the alignment of the patterns with the direction of the applied field. The switching mechanism of the in-plane patterns was by domain wall motion.
NTIS
*Transmission Electron Microscopy; Cobalt; Platinum; Magnetization; Ion Irradiation; Laminates*

**20020016187** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**In-situ TEM - a tool for quantitative observations of deformation behavior in thin films and nano-structured materials**
Stach, E. A.; Sep. 04, 2001; 15p; In English
Report No.(s): DE2001-787170; LBNL-48880; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This paper highlights future developments in the field of in-situ transmission electron microscopy, as applied specifically to the issues of deformation in thin films and nanostructured materials. Emphasis is place on the forthcoming technical advances that will aid in extraction of improved quantitative experimental data using this technique.
NTIS
*Thin Films; Transmission Electron Microscopy; Deformation; Quantitative Analysis; Nanotechnology*

**20020016188** California Univ., Berkeley, CA USA
**Technical design aspects of Feasibility Study-II**
Zisman, M. S.; Aug. 15, 2001; 10p; In English
Report No.(s): DE2001-787167; LBNL-48814; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Feasibility Study-II examined a high-performance Neutrino Factory providing 1 x 10(exp 20) neutrinos per year aimed at a long-baseline detector. The Study was sponsored jointly by BNL and the Neutrino Factory and Muon Collider Collaboration ration (MC) and is based on a 1 MW proton driver operating at 24 GeV, i.e., an upgraded version of the AGS accelerator. Compared with the earlier FNAL-sponsored study (Feasibility Study-I), there is a sixfold improvement in performance. Here we describe details of the implementation of Study-II concepts and discuss their efficacy. Alternative approaches that will be pursued in follow-on R & D activities are also described briefly.
NTIS
*Neutrinos; Muons; Feasibility Analysis*

**20020016189** California Univ., Berkeley, CA USA
**Ultra-peripheral collisions of relativistic heavy ions**
Klein, S.; Jan. 01, 2001; 5p; In English
Report No.(s): DE2001-787163; LBNL-48775; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We report the first observation of exclusive p production in ultra-peripheral collisions at RHIC. The p are produced electromagnetically at large impact parameters where no hadronic interactions occur. The produced p have a small perpendicular momentum, consistent with production that is coherent on both the photon emitting and scattering nuclei. We observe both exclusive p production and p production accompanied by electromagnetic dissociation of both nuclei. We discuss models of vector meson production and the correlation with nuclear breakup.
NTIS
*Heavy Ions; Ionic Collisions; Linear Accelerators*

**20020016190** California Univ., Berkeley, CA USA
**Synchrotron radiation and beam tube vacuum in a Very Large Hadron Collider, Stage 1 and Stage 2 VLHC**
Pivi, M.; Turner, W. C.; Bauer, P.; Limon, P.; Jun. 30, 2001; 3p; In English
Report No.(s): DE2001-787159; LBNL-48683; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Synchrotron radiation induced photodesorption in particle accelerators may lead to pressure rise and to beam-gas scattering losses, finally affecting the beam lifetime (1). We discuss the beam tube vacuum in the low field Stage 1 and Stage 2 Very Large Hadron Collider VLHC. Since VLHC Stage 1 has a room temperature beam tube, a non-evaporable getter (NEG St101 strip) pumping system located inside a pumping ante-chamber, supplemented by lumped ion pumps for pumping methane is considered. In Stage 2, the approx. 100 deg.K beam screen, or liner, illuminated by the synchrotron radiation, is inserted into the magnet cold bore. Cryo-pumping is provided by the cold bore kept at 4.2 deg.K, through slots covering the beam screen surface. Possible beam conditioning scenarios are presented for reaching design intensity, both for Stage 1 and 2. The most important results are summarized in this paper.
NTIS
*Synchrotrons; Beams (Radiation); Radiation; Vacuum; Tubes; Particle Accelerators*

**20020016191** California Univ., Berkeley, CA USA
**Single SQUID frequency-domain multiplexer for large bolometer arrays**
Yoon, J.; Clarke, J.; Gildemeister, J. M.; Lee, A. T.; Myers, M. J.; Aug. 20, 2001; 2p; In English
Report No.(s): DE2001-787158; LBNL-48678; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We describe the development of a frequency-domain superconducting quantum interference device (SQUID) multiplexer which monitors a row of low-temperature sensors simultaneously with a single SQUID. Each sensor is ac biased with a unique frequency and all the sensor currents are added in a superconducting summing loop. A single SQUID measures the current in the summing loop, and the individual signals are lock-in detected after the room temperature SQUID electronics. The current in the summing loop is nulled by feedback to eliminate direct crosstalk. We have built an eight-channel prototype and demonstrated channel separation and signal recovery.
NTIS
*Squid (Detectors); Frequencies; Domains; Monitors*

**20020016194** California Univ., Berkeley, CA USA

**Very Large Hadron Collider: The farthest energy frontier**

Barletta, W. A.; Jun. 21, 2001; 5p; In English

Report No.(s): DE2001-787144; LBNL-48358; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Very Large Hadron Collider (or Eloisatron) represents what may well be the final step on the energy frontier of accelerator-based high energy physics. While an extremely high luminosity proton collider at 100-200 TeV center of mass energy can probably be built in one step with LHC technology, that machine would cost more than what is presently politically acceptable. This talk summarizes the strategies of collider design including staged deployment, comparison with electron-positron colliders, opportunities for major innovation, and the technical challenges of reducing costs to manageable proportions. It also presents the priorities for relevant R&D for the next few years.

NTIS

*Design Analysis; Hadrons; Linear Accelerators*

**20020016195** California Univ., Berkeley, CA USA

**Beam measurements on the H- source and Low Energy Beam Transport system for the Spallation Neutron Source**

Thomae, R.; Gough, R.; Keller, R.; Leung, K. N.; Schenkel, T.; Sep. 01, 2001; 18p; In English

Report No.(s): DE2001-787139; LBNL-48169; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The ion source and Low Energy Beam Transport section of the front-end systems presently being built by Berkeley Lab are required to provide 50 mA of H beam current at 6% duty factor (1 ms pulses at 60 Hz) with a normalized rms emittance of less than 0.20 pi-mm-mrad. Experimental results, including emittance, chopping, and steering measurements on the performance of the ion source and LEBT system operated at the demanded beam parameters will be discussed.

NTIS

*Neutron Sources; Ion Sources; Spallation*

**20020016237** California Univ., Berkeley, CA USA

**Ion-source and LEBT issues with the front-end systems for the Spallation Neutron Source**

Keller, R.; Cheng, D.; DiGennaro, R.; Gough, R. A.; Greer, J.; Sep. 01, 2001; 19p; In English

Report No.(s): DE2001-787119; LBNL-47709; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Front-End Systems (FES) of the Spallation Neutron Source (SNS) project are being built by Berkeley Lab and will deliver a pulsed 40-mA H ion beam at 2.5 MeV energy to the subsequent Drift-Tube Linac. The FES accelerator components comprise an rf driven, volume-production, cesium-enhanced, multi-cusp Ion Source; an electrostatic Low-Energy Beam Transport (LEBT) that includes provisions for transverse focusing, steering, and beam chopping; an RFQ accelerator; and a Medium-Energy Beam Transport (MEBT) line. The challenges for Ion Source and LEBT design are the generation of a plasma suitable for creating the required high H ion density, lifetime of the rf antenna at 6% duty factor, removal of the parasitic electron population from the extracted negative ions, and emittance conservation. The paper discusses these issues in detail and highlights key experimental results obtained so far.

NTIS

*Neutron Sources; Spallation; Ion Beams; Plasmas (Physics); Linear Accelerators*

**20020016239** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Meson exchange model for the YN interaction**

Haidenbauer, J.; Melnitchouk, W.; Speth, J.; Sep. 01, 2001; 5p; In English

Report No.(s): DE2001-787037; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present a new model for the hyperon-nucleon (Lambda N, Sigma N) interaction, derived within the meson exchange framework. The model incorporates the standard one boson exchange contributions of the lowest pseudo-scalar and vector meson multiplets with coupling constants fixed by SU(6) symmetry relations. In addition - as the main feature of the new model - the exchange of two correlated pions or kaons, both in the scalar-isoscalar (sigma) and vector-isovector (rho) channels, is included.

NTIS

*Mesons; Nuclear Models; Energy Levels*

**20020016240** California Univ., Berkeley, CA USA

**Dedicated synchrotron light source for ultrafast x-ray science**

Corlett, J.; DeSantis, S.; Hartman, N.; Heimann, P.; Lafever, R.; Jun. 16, 2001; 3p; In English

Report No.(s): DE2001-786928; LBNL/PUB-5466; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We describe a proposed femtosecond synchrotron radiation x-ray source based on a flat-beam RF gun and a recirculating superconducting linac that provides beam to an array of undulators and bend magnets. X-ray pulse durations of <100 fs at a 10 kHz repetition rate are obtained by a combination of electron pulse compression, transverse temporal correlation of the electrons, and x-ray pulse compression.
NTIS
*Electron Guns; Light Sources; Linear Accelerators; Synchrotron Radiation; X Rays*

**20020016274** Ettore Majorana Centre for Scientific Culture, Erice Italy
**Quantum Devices and Nanostructures: QDN-2**
Jul. 27, 2001; 25p; In English; Second International School on Quantum Devices and Nanostructures, 19-27 Jul. 2001, Erice, Italy
Contract(s)/Grant(s): N00014-01-1-1078
Report No.(s): AD-A396566; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report consists of the schedule for the Second International School on Quantum Devices and Nanostructures, and contact information for the presenters, as well as selected abstracts of presentations.
DTIC
*Quantum Electronics; Nanostructures (Devices)*

**20020016283** Princeton Univ., Plasma Physics Lab., NJ USA
**Results of High Harmonic Fast Wave Heating Experiments on NSTX**
Hosea, J. C.; Bell, R. E.; Bitter, M.; Bonoli, P.; Carter, M.; Aug. 09, 2001; 8p; In English
Report No.(s): DE2001-787788; PPPL-3595; No Copyright; Avail: Department of Energy Information Bridge
The study of high-harmonic fast-wave (HHFW) heating and current drive is being conducted on the National Spherical Torus Experiment (NSTX) device to determine the physics of applying radio-frequency (rf) waves at high harmonics (approximately 10-20) of the ion cyclotron frequency in this high-beta plasma regime and to extend the performance of the NSTX plasma. The magnetic field of this low aspect ratio device is lower (less than or equal to 0.35 T for this work) than that for the typical moderate aspect ratio tokamak regime by about an order of magnitude and the plasma densities achieved are typically in the mid 10(superscript ’’) m(superscript ’’) range. Thus, the dielectric constant of the plasma, epsilon always equals omega (subscript ’’)(superscript ’’) divided by omega (subscript ’’)(superscript ’’), is of order approximately 50-100 resulting in wave physics properties which favor electron heating by TTMP and Landau damping. Radio-frequency power is applied on NSTX at 30 MHz using an antenna array with 12 current straps aligned in the poloidal direction. The antenna can be phased to launch waves with toroidal wave numbers, k(subscript ’’) between 2 m(superscript ’’) and 14 m(superscript "-1") and can be phased for current drive with peak toroidal directionality at 7 m(superscript ’’). to date most of the HHFW experiments have been carried out using k(subscript ’’) = 14 m(superscript ’’) with 0-pi-0-pi-... phasing of the strap currents. The diagnostic complement on NSTX includes a 30-Hz, 10-spatial-channel Thomson scattering (MPTS) system for measuring profiles of electron temperature and density every 33 msec, and a charge-exchange recombination spectroscopy (CHERS) system for measuring profiles of the impurity ion temperature and toroidal rotation during a neutral-beam blip. Strong electron and ion heating are observed in helium discharges, whereas the heating efficiency is noticeably reduced for deuterium discharges. A detailed comparison between helium and deuterium discharge responses at k(subscript ’’) = 14 m(superscript ’’) is presented here. Also, initial results for different radio-frequency phasing and start-up assist experiments will be discussed briefly.
NTIS
*Electric Power Supplies; Harmonics; Electromagnetic Surface Waves; Cyclotron Frequency; Deuterium*

**20020016296** Fermi National Accelerator Lab., Batavia, IL USA
**Improved D0 W boson mass determination**
Abazov, V. M.; Oct. 03, 2001; 11p; In English
Report No.(s): DE2001-787313; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We present a measurement of the W boson mass in proton-antiproton collisions at (radical)s = 1.8 TeV based on a data sample of 82 pb(sup -1) integrated luminosity collected by the D0 detector at the Fermilab Tevatron. We utilize e(nu) events in which the electron shower is close to the phi edge of one of the 32 modules in the D0 central calorimeter. The electromagnetic calorimeter response and resolution in this region differs from that in the rest of the module and electrons in this region were not previously utilized. We determine the calorimeter response and resolution in this region using Z (yields) ee events. We extract the W boson

mass by fitting to the transverse mass and to the electron and neutrino transverse momentum distributions. The result is combined with previous D0 results to obtain an improved measurement of the W boson mass: m(sub W) = 80.483 plus or minus 0.084 GeV.
NTIS
*Bosons; Mass; Particle Accelerators; Particle Collisions; Proton-Antiproton Interactions*

**20020016360** Brookhaven National Lab., Upton, NY USA
**Second Feasibility Study of a Muon Storage Ring Neutrino Factory**
Ozaki,; Palmer, B.; Zisman, S.; Jun. 18, 2001; 8p; In English
Report No.(s): DE2001-787632; BNL-68638; No Copyright; Avail: Department of Energy Information Bridge
The design and simulated performance of a second feasibility study are presented. The efficiency of producing muons is approximately 0.17 microns/p with 24 GeV protons. This study was sponsored by the Brookhaven National Laboratory (BNL) Director, with BNL site specific driver and layout. It was a follow on to the First Study sponsored by the Fermilab Director, with Fermilab site specific driver and layout, and was the main US collaboration conceptual effort during the past year. Other studies, and technical work by the collaboration is reported in other papers.
NTIS
*Feasibility Analysis; Muons; Neutrinos; Storage Rings (Particle Accelerators)*

**20020016361** Brookhaven National Lab., Upton, NY USA
**Longitudinal Ionization Cooling without Wedges**
Berg, S.; Jun. 18, 2001; 4p; In English
Report No.(s): DE2001-787631; BNL-68639; No Copyright; Avail: Department of Energy Information Bridge
The emittance of a muon beam must be reduced very rapidly due to the finite lifetime of the muons. The most effective known way to accomplish this is ionization cooling. It is straightforward to reduce transverse emittance through ionization cooling, but the reducing the longitudinal emittance is more challenging. Longitudinal cooling is necessary for a muon collider, and would be helpful for a neutrino factory. The method traditionally proposed for longitudinal cooling is emittance exchange involving wedges of absorber material: the longitudinal emittance is reduced at the cost of increased transverse emittance. The larger transverse emittance can then be reduced straightforwardly. An alternative method is proposed here, which does not require wedges of material but instead makes slight modifications to the standard transverse cooling lattice. We demonstrate a lattice which is a slight modification to a standard Super FOFO transverse cooling lattice, which has linear eigenvalues all of which have magnitude less than one.
NTIS
*Emittance; Ionization; Muons; Wedges; Cooling Systems*

**20020016362** Brookhaven National Lab., Upton, NY USA
**Dogbone Geometry for Recirculating Accelerators**
Berg, S.; Johnstone,; Summers,; Jun. 18, 2001; 4p; In English
Report No.(s): DE2001-787630; BNL-68640; No Copyright; Avail: Department of Energy Information Bridge
Most scenarios for accelerating muons require recirculating acceleration. A racetrack shape for the accelerator requires particles with lower energy in early passes to traverse almost the same length of arc as particles with the highest energy. This extra arc length may lead to excess decays and excess cost. Changing the geometry to a dogbone shape, where there is a single linac and the beam turns completely around at the end of the linac, returning to the same end of the linac from which it exited, addresses this problem. In this design, the arc lengths can be proportional to the particle's momentum. This paper proposes an approximate cost model for a recirculating accelerator, attempts to make cost-optimized designs for both racetrack and dogbone geometries, and demonstrates that the dogbone geometry does appear to be more cost effective.
NTIS
*Linear Accelerators; Muons; Shape Optimization*

**20020016363** Brookhaven National Lab., Upton, NY USA
**Investigation of the Beam Monitor for the Cluster Klystron**
Zhao,; Aug. 21, 2001; 20p; In English
Report No.(s): DE2001-787629; BNL-68641; No Copyright; Avail: Department of Energy Information Bridge

The cluster klystron project required a beam monitor to check the quality of the hollow beam shape. Since the power density of the beam is very large, a common phosphorescent screen doesn't work. We investigated various types of monitors. The related problems were also discussed.
NTIS
*Klystrons; Monitors*

**20020016381** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Microphonics Testing of the CEBAF Upgrade 7-Cell Cavity**
Davis, G. K.; Delayen, J. R.; Drury, M.; Hiatt, T.; Hovater, C.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783669; JLAB-ACT-01-10; DOE/ER/40150-1884; No Copyright; Avail: Department of Energy Information Bridge
An upgrade cryomodule is being developed for CEBAF at Jefferson Lab. In support of this effort, vibration testing was performed on a single SRF cavity at cryogenic temperature in a Horizontal Test Bed. The tests included response to excitation from background vibration, swept sinusoids, high-power RF pulses, and mechanical impulses. Test procedures, apparatus, and results are presented, along with a description of planned follow-up tests.
NTIS
*Cryostats; Linear Accelerators*

**20020016382** Brookhaven National Lab., Upton, NY USA
**Fast digital orbit feedback systems at NSLS**
Podobedov,; Kushner,; Ramamoorthy,; Tang,; Zitvogel,; Jun. 18, 2001; 5p; In English
Report No.(s): DE2001-783739; BNL-68408; No Copyright; Avail: Department of Energy Information Bridge
We are implementing digital orbit feedback systems to replace the analog ones in both the VUV and the X-ray rings. We developed an original VME-based design which is run by a powerful Motorola 2305 CPU and consists entirely of off-the-shelf VME boards. This makes the system inexpensive and easy to configure, and allows for high digitizing rates. The new 5 kHz digital global feedback system is currently operational in the VUV ring, and the X-ray system is in the commissioning phase. Some of the parameters achieved include vertical correction bandwidth of 200 Hz (at DC gain of 100) and typical orbit drift over a fill of less than 3% of the rms beam size. In this paper we discuss the system architecture, implementation and performance.
NTIS
*Feedback; Storage Rings (Particle Accelerators); Digital Systems*

**20020016385** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Processing Test Stand for the Fundamental Power Couplers of the Spallation Neutron Source (SNS) Superconducting Cavities**
Stirbet, M.; Campisi, I. E.; Davis, G. K.; Drury, M.; Grenoble, C.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783667; JLAB-ACT-01-08; DOE/ER/40150-1882; No Copyright; Avail: Department of Energy Information Bridge
A test stand has been designed, constructed and commissioned for the processing of the SNS superconducting cavity fundamental power couplers. The cart is designed for insertion into a high-power (1 MW and higher) RF system at 805 MHz and it includes a complete vacuum pumping system, a bakeout control system and, in separate racks, all the controls for the RF conditioning, including interlocks, diagnostics and data acquisition systems.
NTIS
*Neutron Sources; Spallation*

**20020016386** Argonne National Lab., IL USA
**Radiation environment in and near high gradient rf cavities**
Ducas, L.; Norem, J.; Geer, S.; Moretti, A.; Popovic, M.; Jul. 23, 2001; 3p; In English
Report No.(s): DE2001-783663; ANL-HEP-CP-01-66; No Copyright; Avail: Department of Energy Information Bridge
The radiation environment in and near high gradient rf cavities is very important for the instrumentation of the MUCOOL experiment, since large fluxes of x rays and dark current electrons can interfere with the operation of the muon detectors. We have measured the x ray and dark current spectra from a single cell, 1.3 GHz, and are beginning to make more extensive measurements

of a multicelled 805 MHz cavity. The results are consistent with electron field emission, bremsstrahlung and photon absorption/scattering. We discuss ways of minimizing this background and the scaling of these results to other cavities.
NTIS
*Cavities; Muons*

**20020016391** Brookhaven National Lab., Upton, NY USA
**Design of beam-extraction septum magnet for the SNS**
Tsoupas,; Lee,; Rank,; Tuozzolo,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783731; BNL-68039; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The beam-extraction process from the SNS accumulator ring (1,2) requires a Lambertson septum magnet. In this paper we discuss the geometrical and magnetic field requirements of the magnet and present results obtained from two and three dimensional magnetic field calculations that shows the field quality in the regions of interest of the septum magnet.
NTIS
*Spallation; Accumulators; Extraction; Septum; Storage Rings (Particle Accelerators)*

**20020016409** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**High-gradient normal-conducting RF structures for muon cooling channels**
Corlett, J. N.; Green, M. A.; Hartman, N.; Ladran, A.; Li, D.; Jun. 12, 2001; 3p; In English
Report No.(s): DE2001-783877; LBNL-48198; No Copyright; Avail: Department of Energy Information Bridge
We present a status report on the research and development of high-gradient normal-conducting RF structures for the ionization cooling of muons in a neutrino factory or muon collider. High-gradient RF structures are required in regions enclosed in strong focusing solenoidal magnets, precluding the application of superconducting RF technology. We propose using linear accelerating structures, with individual cells electromagnetically isolated, to achieve the required gradients of over 15 MV/m at 201 MHz and 30 MV/m at 805 MHz. Each cell will be powered independently, and cell length and drive phase adjusted to optimize shunt impedance of the assembled structure. This efficient design allows for relatively small field enhancement on the structure walls, and an accelerating field approximately 1.7 times greater than the peak surface field. The electromagnetic boundary of each cell may be provided by a thin Be sheet, or an assembly of thin-walled metal tubes. Use of thin, low-Z materials will allow passage of the muon beams without significant deterioration in beam quality due to scattering. R and D in design and analysis of robust structures that will operate under large electric and magnetic fields and RF current heating are discussed, including the experimental program based in a high-power test laboratory developed for this purpose.
NTIS
*Muons; Cooling Systems; Ionization; Radio Frequencies*

**20020016421** Brookhaven National Lab., Upton, NY USA
**Longitudinal density modulation of unstable bunches emitting coherent IR**
Podobedov,; Carr,; Kramer,; Murphy,; Jun. 18, 2001; 5p; In English
Report No.(s): DE2001-783738; BNL-68407; No Copyright; Avail: Department of Energy Information Bridge
Brookhaven National Laboratory's Accelerator Test Facility (ATF) has embarked on a complete upgrade of its decade old computer system. The planned improvements affect every major component: processors (Intel Pentium replaces VAXes), operating system (Linux/Real-Time Linux supplants OpenVMS), and data acquisition equipment (fast Ethernet equipment replaces CAMAC serial highway.) This paper summarizes the strategies and progress of the upgrade along with plans for future expansion.
NTIS
*Test Facilities; Particle Accelerators; Computers*

**20020016422** Brookhaven National Lab., Upton, NY USA
**Transversity single spin asymmetries**
Boer,; Apr. 27, 2001; 6p; In English
Report No.(s): DE2001-783737; BNL-68417; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The theoretical aspects of two leading twist transversity single spin asymmetries, one arising from the Collins effect and one from the interference fragmentation functions, are reviewed. Issues of factorization, evolution and Sudakov factors for the

relevant observables are discussed. These theoretical considerations pinpoint the most realistic scenarios towards measurements of transversity.
NTIS
*Quantum Chromodynamics; Asymmetry*

**20020016425** Brookhaven National Lab., Upton, NY USA
**Power supply control and monitoring for the SNS ring and transport system**
Lambiase,; Oerter,; Peng,; Smith,; Jun. 28, 2001; 3p; In English
Report No.(s): DE2001-783732; BNL-68046; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There are approximately 300 magnet power supplies in the SNS accumulator ring and transport lines. Control and monitoring of the these converters will be primarily accomplished with a new Power Supply Interface and Controller (PSI/PSC) system developed for the SNS project. This PSI/PSC system provides all analog and digital commands and status readbacks in one fiber isolated module. With a maximum rate of 10KHz, the PSI/PSC must be supplemented with higher speed systems for the wide bandwidth pulsed injection supplies, and the even wider bandwidth extraction kickers. This paper describes the implementation of this PSI/PSC system, which was developed through an industry/laboratory collaboration, and the supplementary equipment used to support the wider bandwidth pulsed supplies.
NTIS
*Power Supplies; Accumulators; Controllers; Supplying; Extraction*

**20020016431** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**High Accuracy Beam Current Monitor of the CEBAF Hall A**
Denard, J. C.; Saha, A.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783671; JLAB-ACT-01-12; DOE/ER/40150-1886; No Copyright; Avail: Department of Energy Information Bridge

A beam current monitor system was developed to measure the CW electron beam current delivered to the CEBAF Hall A. The experiments require non-invasive measurements during beam delivery, with an absolute accuracy better than 0.2% in the current range from 1 to 180 mu-A. Two redundant cavities, and their associated electronics, monitor the beam current continuously. They are periodically calibrated with respect to a Parametric Current Transformer (PCT) manufactured by Bergoz, having an accurate and stable sensitivity of 4 mu-A/V, but having offset drifts at the mu-A level that prevent its direct use as a non-invasive device. A beam current of at least 50 mu-A is repetitively turned on and off during the calibration process to reduce the error due to the PCT offset drifts. This is invasive to beam delivery, and one of the goals is to minimize the calibration time without compromising accuracy. This paper describes the beam current monitor system, identifies the sources of error, and reports on the system's performance during actual machine operations.
NTIS
*Beam Currents; Electron Beams; Linear Accelerators*

**20020016432** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Cebaf upgrade cryomodule component testing in the Horizontal Test Bed (HTB)**
Campisi, I. E.; Carpenter, B.; Davis, G. K.; Delayen, J.; Drury, M.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783668; JLAB-ACT-01-09; DOE/ER/40150-1883; No Copyright; Avail: Department of Energy Information Bridge

The planned upgrade of the CEBAF electron accelerator includes the development of an improved cryomodule. Several components differ substantially from the original CEBAF cryomodule; these include: the new 7-cell, 1.5 GHz cavities with integral helium vessel, a new, backlash-free cavity tuner, the waveguide coupler with its room-temperature ceramic window, and the HOM damping filters. In order to test the design features and performance of the new components, a horizontal cryostat (Horizontal Test Bed) has been constructed which allows testing with a turn around time of less than three weeks. This cryostat provides the environment for testing one or two cavities, with associated auxiliary components, in a condition similar to that of a real cryomodule. A series of tests has been performed on a prototype 7-cell cavity and the above-mentioned systems. In this paper the results of the tests on the cryostat, on the cavity performance, on its coupler, on the tuner characteristics, and on the microphonics behavior will be reported.
NTIS
*Cryostats; Electron Accelerators; Test Facilities*

**20020016433** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Development and Testing of a Prototype Tuner for the CEBAF Upgrade Cryomodule**

Davis, G.; Delayen, J.; Drury, M.; Feldl, E.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783666; JLAB-ACT-01-07; DOE/ER/40150-1881; No Copyright; Avail: Department of Energy Information Bridge

An upgrade cryomodule is being developed for CEBAF at Jefferson Lab. The high-gradient, low-current operation of the superconducting cavities puts stringent requirements on the accuracy of the frequency tuner: a resolution of 1 Hz over a range of 400 KHz. We have developed and tested such a tuner; it consists of a stepper-motor-driven coarse tuner, operating in parallel with a piezo-actuator-driven fine tuner. Tuner test procedures and results are summarized, including frequency resolution, range, and linearity (i.e. frequency vs. tuner position), as well as microphonic effects resulting from tuner operation.

NTIS

*Linear Accelerators; Tuners; Frequency Control*

**20020016435** Argonne National Lab., IL USA

**Transformer ratio enhancement using a ramped bunch train in a collinear Wakefield Accelerator**

Power, J. G.; Gai, W.; Sun, X.; Kanareykin, A.; Jul. 19, 2001; 3p; In English

Report No.(s): DE2001-783664; ANL-HEP-CP-01-62; No Copyright; Avail: Department of Energy Information Bridge

We present a practical method for achieving a transformer ratio (R) greater than 2 with any collinear wakefield accelerator i.e., with either plasma or structure based wakefield accelerators. It is known that the transformer ratio cannot generally be greater than 2 for a symmetric drive bunch in a collinear wakefield accelerator. However, using a ramped bunch train (RBT) where a train of n electron drive bunches, with increasing (ramping) charge, one can achieve R = 2n after the bunch train. We believe this method is feasible from an engineering standpoint. We describe a proof of principle experiment using an disk-loaded waveguide, of frequency 13.65 GHz, driven by a RBT of 4 electron bunches. We expect to achieve R greater than 6 using 4 electron bunches. Details of the simulation and experimental design are presented.

NTIS

*Transformers; Particle Accelerators*

**20020016437** Argonne National Lab., IL USA

**Instrumentation for the muon based neutrino source**

Norem, J.; Wang, C. X.; Solomey, N.; Jul. 17, 2001; 3p; In English

Report No.(s): DE2001-783661; ANL-HEP-CP-01-69; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There are a number of novel instrumentation issues relating to the generation cooling and acceleration of high power muon beams. Specific issues are monitoring the cooling water in the magnet nearest the target to minimize corrosion, monitoring the behavior of the target after the impact of the beam, and following the beam through the cooling accelerator chain. The muon cooling system also produces a number of unique issues such as making beam profile measurements in the presence of large backgrounds, measuring these backgrounds, losses, and the angular momentum of the beam. We describe the techniques we intend to use, and some of the constraints involved in their implementation.

NTIS

*Cooling Systems; Muons; Neutrinos*

**20020016438** Argonne National Lab., IL USA

**Experimental demonstration of two beam acceleration using dielectric step-up transformer**

Gai, W.; Conde, M. E.; Konecny, R.; Power, J. G.; Schoessow, P.; Jul. 17, 2001; 3p; In English

Report No.(s): DE2001-783660; ANL-HEP-CP-01-60; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We report on the experimental results of the dielectric based two beam accelerator (step-up transformer). by using a single high charge beam, we have generated and extracted a high power RF pulse from a 7.8 GHz primary dielectric structure and then subsequently transferred to a second accelerating structure with higher dielectric constant and smaller transverse dimensions. We have measured the energy change of a second (witness) beam passing through the acceleration stage. The measured gradient is greater than 4 times the deceleration gradient. The detailed experiment of set-up and results of the measurements are discussed. Future plans for the development of a 100 MeV demonstration accelerator based on this technique is presented.

NTIS

*Particle Beams; Dielectrics*

**20020016440** Argonne National Lab., IL USA

**Hybrid dielectric and iris loaded periodic accelerating structure**

Zou, P.; Xiao, L.; Sun, X.; Gai, W.; Jul. 17, 2001; 3p; In English

Report No.(s): DE2001-783658; ANL-HEP-CP-01-64; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

One disadvantage of conventional iris-loaded accelerating structures is the high ratio of the peak surface electric field to the peak axial electric field useful for accelerating a beam. Typically this ratio E(sub s)/E(sub a) (ge) 2. The high surface electric field relative to the accelerating gradient may prove to be a limitation for realizing technologies for very high gradient accelerators. In this paper, we present a scheme that uses a hybrid dielectric and iris loaded periodic structure to reduce E(sub s)/E(sub a) to near unity, while the shunt impedance per unit length r and the quality factor Q compare favorably with conventional metallic structures. The analysis based on MAFIA simulations of such structures shows that we can lower the peak surface electric field close to the accelerating gradient while maintaining high acceleration efficiency as measured by r/Q. Numerical examples of X-band hybrid accelerating structures are given.

NTIS

*Dielectrics; Hybrid Structures*

**20020016442** Argonne National Lab., IL USA

**Field analysis of a dielectric-loaded rectangular waveguide accelerating structure**

Xiao, L.; Gai, W.; Sun, X.; Jul. 16, 2001; 3p; In English

Report No.(s): DE2001-783656; ANL-HEP-CP-01-63; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this paper, we present a detailed analysis of the modes of a dielectric-loaded rectangular waveguide accelerating structure. In general, the acceleration field in a synchronous acceleration mode is non-uniform in the two transverse dimensions. However, we could use an array of these structures rotated alternatively by 90 degrees to get a focusing-defocusing force continuously as a simple FODO lattice, while maintaining uniform energy gain. The expressions of characteristic parameters such as R/Q, group velocity and attenuation constant are given. The longitudinal wake field experienced by a relativistic charged particle beam in the structure is also presented. These analytical results are also compared with numerical calculations using the MAFIA code suite demonstrating the validity of our analytic approach.

NTIS

*Dielectrics; Waveguides*

**20020016459** Princeton Univ., Plasma Physics Lab., NJ USA

**Diamagnetic Fishbone Mode Associated with Circulating Fast Ions in Spherical Tokamaks**

Kolesnichenko, Y. I.; Marchenko, V. S.; White, R. B.; Jun. 19, 2001; 9p; In English

Report No.(s): DE2001-787680; PPPL-3581; No Copyright; Avail: Department of Energy Information Bridge

Recently it was shown theoretically that high beta (beta is the ratio of the plasma pressure to the magnetic field pressure) inherent to plasmas of Spherical Tokamaks (ST) stabilizes the fishbone mode associated with the trapped particles. This prediction agrees with the experimental observations of the fishbone behavior on the Small Tight Aspect Ratio Tokamak (START). However, in the mentioned experiments the circulating particles rather than the trapped ones were dominant in the energetic ion population. Therefore, the theory of Kolesnichenko et al. is not sufficient to explain the START experiment and predict the behavior of the circulating-particle-induced fishbone mode in future experiments on STs. Thus, a new theory is required, which stimulated the fulfillment of this present work. There are two fishbone branches: the high-frequency (precession) branch and the low-frequency (diamagnetic) one. In this work, we restrict ourselves with the study of the low-frequency branch. The stability of this branch associated with the circulating particles in a low-beta plasma was studied by Betti et al.; no attempts to consider high beta plasmas were done yet.

NTIS

*Circulation; Diamagnetism; Ions; Plasmas (Physics); Tokamak Devices; Trapped Particles*

**20020016461** Fermi National Accelerator Lab., Batavia, IL USA

**Inclusive Jet Cross Section in p pbar Collisions at square root s = 1.8 TeV Using the kT Algorithm**

Abazov, V. M.; Oct. 15, 2001; 12p; In English

Report No.(s): DE2001-787652; No Copyright; Avail: Department of Energy Information Bridge

We present a preliminary measurement of the central inclusive jet cross section using a successive combination algorithm based on relative transverse momenta for jet reconstruction. We analyze a 87.3/pb data sample collected by the D0 detector at the

Fermilab Tevatron p(bar p) Collider during 1994-1995. The cross section, reported as a function of transverse momentum (p(sub T) is greater than 60 GeV) in the central region of pseudo-rapidity (eta is less than 0.5), is in reasonable agreement with next-to-leading order QCD predictions. This is the first jet production measurement in a hadron collider using a successive combination type of jet algorithm.
NTIS
*Algorithms; Collisions; Quantum Chromodynamics; Elementary Particle Interactions*

**20020016600** TMET, Winchester, TN USA
**Exploration of Anomalous Gravity Effects by rf-Pumped Magnetized High-T(c) Superconducting Oxides**
Robertson, Tony, NASA Marshall Space Flight Center, USA; Litchford, Ron; Peters, Randall, NASA Marshall Space Flight Center, USA; Thompson, Byran, Mercer Univ., USA; [2001]; 3p; In English; AIAA Joint Propulsion Conference, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A number of anomalous gravitational effects have been reported in the scientific literature during recent years, but there has been no independent confirmation with regard to any of these claims. Therefore, the NASA Marshall Space Flight Center, in response to the propulsion challenges specified by NASA's Breakthrough Propulsion Physics (BPP) program, proposed to explore the possibility of observing anomalous gravitation behavior through the manipulation of Josephson junction effects in magnetized high-Tc superconducting oxides. The technical goal was to critically test this revolutionary physical claim and provide a rigorous, independent, empirical confirmation (or refutation) of anomalous effects related to the manipulation of gravity by radio frequency (rf)-pumped magnetized type-2 superconductors. Because the current empirical evidence for gravity modification is anecdotal, our objective was to design, construct, and meticulously implement a discriminating experiment, which would put these observations on a more firm footing within the scientific community. Our approach is unique in that we advocate the construction of an extremely sensitive torsion balance with which to measure gravity modification effects by rf-pumped type-2 superconductor test masses. This paper reviews the anecdotal evidence for anomalous gravity effects, describes the design and development of a simplified torsion balance experiment for empirically investigating these claims, and presents the results of preliminary experiments.
Author
*Gravitational Effects; Gravity Anomalies; High Temperature Superconductors*

**20020016658** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**First Experiment on Spectroscopy of Lambda-Hypernuclei by Electroproduction at JLab**
Tang, L.; Jul. 01, 2001; 13p; In English
Report No.(s): DE2001-783699; JLAB-PHY-01-18; DOE/ER/40150-1891; No Copyright; Avail: Department of Energy Information Bridge

The first experiment in Lambda-hypernuclear spectroscopy using the high precision electron beam at Jefferson Laboratory (Jlab) has been carried out. The hypernuclear spectrometer system (HNSS) was used to measure spectra from the C-12(e, e(prime)K(+)) (sup 12, sub Lambda)B reaction with sub-1 MeV resolution, the best energy resolution obtained thus far in hypernuclear spectroscopy with magnetic spectrometers. This paper describes the HNSS and the preliminary results for the (sup 12, sub Lambda)B system. The experimental spectrum is consistent with the expected strong spin-flip excitations of unnatural parity states. A program of hypernuclear physics experiments is planned for the future with much higher yield and even better energy resolution.
NTIS
*Hypernuclei; Magnetic Spectroscopy*

**20020016659** Fermi National Accelerator Lab., Batavia, IL USA
**Method for Calculating Longitudinal Phase Space Distribution When Given the Time Profile of the Bunch**
Tan, C. Y.; Jul. 30, 2001; 19p; In English
Report No.(s): DE2001-783681; FERMILAB-TM-2155; No Copyright; Avail: Department of Energy Information Bridge

We will show in this paper a method for calculating the longitudinal phase space distribution when the time profile of the bunch as measured by a wall current monitor is given. The key to this method is the assumption that the bunch is matched to the bucket. With this assumption, we will show that the method boils down to solving a simple upper triangular matrix equation. We will also illustrate the method with two examples and show the method's shortcomings.
NTIS
*Matrices (Mathematics); Bunching*

**20020016660** Fermi National Accelerator Lab., Batavia, IL USA
**Architecture of a Software Quench Management System**
Nogiec, J. M.; Jul. 30, 2001; 3p; In English
Report No.(s): DE2001-783680; FERMILAB-CONF-01/125; No Copyright; Avail: Department of Energy Information Bridge
Testing superconducting accelerator magnets is inherently coupled with the proper handling of quenches; i.e., protecting the magnet and characterizing the quench process. Therefore, software implementations must include elements of both data acquisition and real-time controls. The architecture of the quench management software developed at Fermilab's Magnet Test Facility is described. This system consists of quench detection, quench protection, and quench characterization components that execute concurrently in a distributed system. Collaboration between the elements of quench detection, quench characterization and current control are discussed, together with a schema of distributed saving of various quench-related data. Solutions to synchronization and reliability in such a distributed quench system are also presented.
NTIS
*Architecture (Computers); Computer Programs; Management Systems; Superconducting Magnets*

**20020016661** Fermi National Accelerator Lab., Batavia, IL USA
**Single-Layer High Field Dipole Magnets**
Kashikhin, V. V.; Zlobin, A. V.; Jul. 30, 2001; 3p; In English
Report No.(s): DE2001-783679; FERMILAB-CONF-01/127; No Copyright; Avail: Department of Energy Information Bridge
Fermilab is developing high field dipole magnets for post-Large Hadron Colliders (LHC). Several designs with a nominal field of 10-12 T, coil bore size of 40-50 mm based on both shell-type and block-type coil geometry are currently under consideration. This paper presents a new approach to magnet design, based on simple and robust single-layer coils optimized for the maximum field, good field quality and minimum number of turns.
NTIS
*Hadrons; High Field Magnets; Magnet Coils*

**20020016662** Fermi National Accelerator Lab., Batavia, IL USA
**Nb3Sn ARC Quadrupole Magnets for VLHC**
Kashikhin, V. V.; Zlobin, A. V.; Jul. 30, 2001; 3p; In English
Report No.(s): DE2001-783678; FERMILAB-CONF-01/126; No Copyright; Avail: Department of Energy Information Bridge
Superconducting quadrupoles with a field gradient of 400-450 T/m for a future Very Large Hadron Collider (VLHC) are being studied at Fermilab. to reach the target field gradient in a 40-50 mm aperture, Nb3Sn superconductor is used at an operating temperature of 4.2 K. Two cases with different magnet functions, beam separation distances and coil arrangements have been analyzed and optimized in order to provide the required field quality and magnet parameters.
NTIS
*Hadrons; Magnets; Quadrupoles; Superconductors (Materials)*

**20020016663** Fermi National Accelerator Lab., Batavia, IL USA
**Design and Development of Nb3Sn Single-Layer Common Coil Dipole Magnet for VLHC**
Ambrosio, G.; Jul. 30, 2001; 3p; In English
Report No.(s): DE2001-783677; FERMILAB-CONF-01/137-E; No Copyright; Avail: Department of Energy Information Bridge
Common coil dipole magnets based on Nb3Sn conductor and the React and Wind technology are a promising option for the next generation of hadron colliders. The react and wind technology has potential cost benefits in terms of cable insulation, structural materials, and magnet fabrication. A common coil design allows the use of pre-reacted Nb3Sn superconductor with low critical current degradation after bending. Fermilab in collaboration with Lawrence Berkeley National Laboratory (LBNL) is involved in the development of a single-layer common-coil dipole magnet with maximum field of 11 T and 40-50 mm aperture, for a future Very Large Hadron Collider (VLHC). The current magnetic and mechanical designs of the dipole model, magnet parameters along with the status of the program, are reported in this paper.
NTIS
*Magnet Coils; Magnetic Dipoles; Hadrons; Superconducting Magnets*

**20020016664** Fermi National Accelerator Lab., Batavia, IL USA
**Quench Protection of High Field Nb3Sn Magnets for VLHC**
Imbasciati, L.; Jul. 30, 2001; 3p; In English
Report No.(s): DE2001-783676; FERMILAB-CONF-01/159-E; No Copyright; Avail: Department of Energy Information Bridge

Fermilab is developing high field magnets for a possible future Very Large Hadron Collider (VLHC). The high levels of stored energy in these magnets present significant challenges to the magnet quench protection. Simulation programs have been developed and used to analyze temperature and voltage distributions during a quench and to performed parametric studies on conductor and quench-heater requirements. This paper concludes with a proposal for a set of quench protection parameters for the VLHC magnets.
NTIS
*Computerized Simulation; Hadrons; High Field Magnets; Linear Accelerators*

**20020016665** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Issues in Acceleration of a Muon Beam for a Neutrino Factory**
Delayen, J.; Douglas, D.; Harwood, L.; Lebedev, V.; Leemann, C.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783674; JLAB-ACT-01-15; DOE/ER/40150-1889; No Copyright; Avail: Department of Energy Information Bridge

We have developed a concept for acceleration of a large phase-space, pulsed muon beam from 190 MeV to 50 GeV as part of a collaborative study of the feasibility of a neutrino factory based on in-flight decay of muons. The muon beam's initial energy spread was approximately 20% and each bunch has the physical size of a soccer ball. Production of the muons will be quite expensive, so prevention of loss due to scraping or decay is critical. The former drives the system to large apertures and the latter calls for high real-estate-average gradients. The solution to be presented utilizes a 3 GeV linac to capture the beam, a four-pass recirculating linac to get the beam to 10 GeV, and then a five-pass linac to get the beam to 50 GeV. Throughout the system, longitudinal dynamics issues far outweighed transverse dynamics issues. This paper focuses on the issues surrounding the choice of superconducting radio frequency structures over copper structures.
NTIS
*Linear Accelerators; Muons; Particle Production*

**20020016670** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Simulation results for the electron-cloud at the PSR**
Furman, M. A.; Pivi, M.; Jun. 26, 2001; 3p; In English
Report No.(s): DE2001-785322; LBNL-48382; CBP NOTE-398; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present a first set of computer simulations for the main features of the electron cloud at the Proton Storage Ring (PSR), particularly its energy spectrum. We compare our results with recent measurements, which have been obtained by means of dedicated probes.
NTIS
*Electrons; Storage Rings (Particle Accelerators); Electron Clouds; Energy Spectra*

**20020016679** Fermi National Accelerator Lab., Batavia, IL USA
**Measured longitudinal beam impedance of booster gradient magnets**
Fellenz, B. J.; Crisp, J. L.; Aug. 24, 2001; 12p; In English
Report No.(s): DE2001-784994; FERMILAB-TM-2145; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Booster gradient magnets have no vacuum pipe which forces the beam image current to flow along the laminated pole tips. Both D and F style magnets were measured with a stretched wire to determine the longitudinal beam impedance caused by these laminations. Results are compared to calculations done 30 years ago. The inductive part of the magnet impedance is interesting because it partially compensates for the negative inductance effects of space charge on the beam. An R/L circuit consisting of 37K in parallel with between 40 and 100uH is a reasonable approximation to the total impedance of Booster magnet laminations.
NTIS
*Magnets; Impedance; Gradients; Beam Currents*

**20020016684** Brookhaven National Lab., Upton, NY USA
**RHIC sequencer**
Van Zeijts,; Dottavio,; Frak,; Michnoff,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-784213; BNL-67981; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Relativistic Heavy Ion Collider (RHIC) has a high level asynchronous time-line driven by a controlling program called the ”Sequencer”. Most high-level magnet and beam related issues are orchestrated by this system. The system also plays an important task in coordinated data acquisition and saving. We present the program, operator interface, operational impact and experience.
NTIS
*Heavy Ions; Particle Collisions; Magnets*

**20020016699** Brookhaven National Lab., Upton, NY USA
**Injection carbon stripping foil issues in the sns accumulator ring**
Beebe-Wang,; Lee,; Raparia,; Wei,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783980; BNL-68095; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We are reporting the results of studies on issues related to the injection stripping foil in the Spallation Neutron Source (SNS) accumulator ring. The problems related to foil heating and foil lifetime, such as current density distribution and temperature distribution in the foil, are investigated. The impact of injection errors on the beam losses at the foil is studied. The particle traversal rate and the beam losses due to scattering in the foil are summarized. Finally, SNS end-to-end simulation results of the foil-missing rate, the foil-hitting rate and the maximum foil temperature are presented.
NTIS
*Beam Injection; Carbon; Foils (Materials); Storage Rings (Particle Accelerators)*

**20020016707** Brookhaven National Lab., Upton, NY USA
**Proceedings of riken bnl research center workshop on spin physics at rhic in year-1 and beyond**
Bland,; Boer,; Saito,; Vogelsang,; May 14, 2001; 249p; In English
Report No.(s): DE2001-785041; BNL-52635; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
During the first year, the Center had only a Theory Group. In the second year, an Experimental Group was also established at the Center. At present there are seven Fellows and nine post docs in these two groups. During the third year, we started a new Tenure Track Strong Interaction Theory (RHIC) Physics Fellow Program, with six positions in the academic year 1999-2000; this program will increase to include eleven theorists in the next academic year, and in the year after, also be extended to experimental physics. In addition, the Center has an active workshop program on strong interaction physics, about ten workshops a year, with each workshop focused on a specific physics problem. Each workshop speaker is encouraged to select few of the most important transparencies from his or her presentation, accompanies by a page of explanation. This material is collected at the end of the workshop by the organizer to form proceedings, which can therefore be available within a short time.
NTIS
*Spin; Physics*

**20020016790** Brookhaven National Lab., Upton, NY USA
**Proposal for a cavity polarimeter at MIT-Bates**
Cameron,; Barry,; Conte,; Goldberg,; Jabobs,; Jun. 18, 2001; 1p; In English
Report No.(s): DE2001-784212; BNL-68465; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The possibility of successfully implementing a cavity polarimeter has been greatly improved by the discovery of a cavity mode for which the magnitude of the Stern-Gerlach force experienced by a magnetic moment traversing the cavity varies as the square of the relativistic factor gamma, so that the signal power varies as the fourth power of gamma. In addition, the interaction of this cavity mode with the beam charge varies as the inverse of the interaction with the magnetic moment, so that the background due to the beam charge varies as the inverse fourth power of gamma, If these gamma dependencies of moment and charge interaction with the pickup cavity do in fact exists the possibility is opened for very fast, accurate, and inexpensive polarimetry at accelerators like MIT-Bates and RHIC. In addition, it might become possible to seriously consider Stern-Gerlach polarization of beams at LHC. We present details of a quick polarimeter test at the electron storage ring at MIT-Bates, and of an extension of this test to a working polarimeter in the RHIC rings.
NTIS
*Magnetic Moments; Polarimeters; Heavy Ions; Particle Collisions*

**20020016903** Fermi National Accelerator Lab., Batavia, IL USA

**Quench Simulation Program for Superconducting Accelerator Magnets**

Kim, S. W.; Aug. 10, 2001; 3p; In English

Report No.(s): DE2001-784269; FERMILAB-CONF-01/085-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In the design of superconducting magnets for accelerator and the quench protection systems, it is necessary to calculate the current, voltage, and temperature during quench. The quench integral value (MIITs) is used to get a rough idea about the quench, but they need numerical calculations to obtain more detailed picture of the quench. A simulation program named KUENCH, which is not based on the MIITs calculation, was developed to calculate voltage, current, and temperature of accelerator magnets during quenches. The software and calculation examples are introduced. The example also gives some important information about effects of copper content in the coil and quench protection heaters.

NTIS

*Simulation; Superconducting Magnets; Quenching*

**20020016904** Fermi National Accelerator Lab., Batavia, IL USA

**Electroweak Theory**

Quigg, C.; Aug. 10, 2001; 65p; In English

Report No.(s): DE2001-784268; FERMILAB-CONF-01/001-T; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

After a short essay on the current state of particle physics, the author reviews the antecedents of the modern picture of the weak and electromagnetic interactions and then undertakes a brief survey of the SU(2)(sub L) multiplied by U(1)(sub Y) electroweak theory. The author reviews the features of electroweak phenomenology at tree level and beyond, presents an introduction to the Higgs boson and the 1-TeV scale, and examines arguments for enlarging the electroweak theory. The author concludes with a brief look at low-scale gravity.

NTIS

*Electroweak Interactions (Field Theory); Electroweak Model; Higgs Bosons*

**20020017532** Fermi National Accelerator Lab., Batavia, IL USA

**Summaries of recent computer-assisted Feynam diagram calculations**

Fischler, M.; Aug. 16, 2001; 5p; In English

Report No.(s): DE2001-784422; FERMILAB-CONF-01/237-T; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The AIHENP Workshop series has traditionally included cutting edge work on automated computation of Feynman diagrams. The conveners of the Symbolic Problem Solving topic in this ACAT conference felt it would be useful to solicit presentations of brief summaries of the interesting recent calculations. Since this conference was the first in the series to be held in the Western Hemisphere, it was decided that the summaries would be solicited both from attendees and from researchers who could not attend the conference. This would represent a sampling of many of the key calculations being performed.

NTIS

*Feynman Diagrams; Computer Techniques; Conferences*

**20020017536** Fermi National Accelerator Lab., Batavia, IL USA

**Magnetic field fluctuations in SC dipole magnet**

Shiltsev, V.; Aug. 15, 2001; 3p; In English

Report No.(s): DE2001-784405; FERMILAB-CONF-01/155; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Magnetic field fluctuations at the betatron frequency can lead to emittance growth in circular accelerators. Tolerances are extremely tight for large hadron colliders like LHC and VLHC. We performed experimental studies of the fluctuations in a stand-alone superconducting Tevatron magnet. Here we give a general description of the experimental set-up, present main results and discuss consequences for the colliders.

NTIS

*Magnetic Fields; Particle Accelerators; Magnetic Dipoles*

**20020017541** Fermi National Accelerator Lab., Batavia, IL USA

**Large Aperture Magnets for a Future High Power Proton Synchrotron**

Ostiguy, J. F.; Mills, F. M.; Aug. 14, 2001; 3p; In English

Report No.(s): DE2001-784340; FERMILAB-CONF-01/160; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A high intensity, high power proton synchrotron is currently under consideration at Fermilab. The machine - known as the Proton Driver - would accelerate 3x10(exp 13) protons from 400 MeV to 12 GeV (stage 1) or 16 GeV (stage 2) and ultimately deliver in excess of 1 MW of beam power. to minimize losses and insure beam stability, the space charge-induced tune shift must be kept well below 0.5. This is accomplished by spreading out bunches both longitudinally and transversely. While the former strategy favors high voltage low frequency radio frequencies, the latter leads to magnets with unconventionally large apertures. This requirement, combined with a 1.5 T bending field and rapid cycling operation results in a number of serious but not insurmountable challenges. In this paper, they discuss the design of the Proton Driver magnets and the rationale behind it.

NTIS

*Magnets; Synchrotrons*

**20020017575** Stanford Linear Accelerator Center, CA USA

**Probing for New Physics in Polarized Lambda(b) Decays at the Z**

Hiller, G.; Aug. 08, 2001; 18p; In English

Report No.(s): DE2001-787178; SLAC-PUB-8752; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Polarized Lambda (sub beta) Lambda (sub gamma) decays at the Z pole are shown to be well suited for probing a large variety of New Physics effects. A new observable is proposed, the angular asymmetry between the Lambda (sub beta) spin and photon momentum, which is sensitive to the relative strengths of the opposite chirality and Standard Model chirality b s gamma a dipole operators. Combination with the Lambda (sub gamma) polarization asymmetry and comparison with the Lambda (sub beta) polarization extracted from semileptonic decays allows important tests of the V - A structure of the Standard Model.

NTIS

*Particle Decay; Linear Polarization*

**20020017576** Argonne National Lab., IL USA

**Direct Drive and Eddy-Current Septum Magnets**

Kim, S. H.; Sep. 13, 2001; 15p; In English

Report No.(s): DE2001-786922; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two types of thin septum magnets, direct drive and eddy current, were compared mainly in 2-D magnetic aspects. For the direct-drive type, the leakage field depended on the finite permeability of the magnet core and not on the thickness of the septum conductor. It was suggested that the leakage field be controlled by reducing the current in the septum conductor or by using a correction coil. There were no significant differences between the two types regarding thermal problems caused by high current densities in the thin septa. The leakage fields with 2-mm septum thicknesses were calculated using OPERA-2d to compare the two types. For the eddy-current type, the leakage fields calculated using OPERA-2d were compared with the calculations from Halbach's model. The leakage fields for the eddy-current type decayed with long time constants.

NTIS

*Eddy Currents; Septum; Magnets*

**20020017690** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**RF systems for the betatron-node scheme experiment at LBNL**

Lidia, S. M.; DeSantis, S.; Houck, T.; Jun. 22, 2001; 3p; In English

Report No.(s): DE2001-785263; LBNL-47337; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two-beam accelerators based upon relativistic klystrons (RK's) have been proposed as power sources for future generation electron-positron linear colliders. These drivers are known to suffer from several transverse beam-breakup (BBU) instabilities. A program to study a particular technique (the "betatron node scheme") of ameliorating the high frequency BBU is under way at LBL. Central to this study are the pillbox RF cavities and RF beam position monitors (BPM's) employed. This paper discusses the design, fabrication, and testing of the RF components. Details of the signal processing and analysis will be presented.

NTIS

*Klystrons; Relativistic Particles; Linear Accelerators*

**20020018027** Academy of Sciences of the Ukraine, Inst. of Radiophysics and Electronics, Kharkov Ukraine
**International Conference on Mathematical Methods in Electromagnetic Theory (MMET 2000), Volume 2** ***Final Report***
Sep. 2000; 350p; In English
Contract(s)/Grant(s): F61775-00-WF084; F68171-00-M-6175
Report No.(s): AD-A396820; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

This is Volume 2 of the final Conference Proceedings of the International Conference on Mathematical Methods in Electromagnetic Theory (MMET 2000) held in Kharkov, Ukraine on September 12-15, 2000. Topics covered include theoretical and applied aspects of antenna theory, asymptotic methods, particle beams, complex media, computational techniques, eigenvalue problems, electromagnetic theory, fiber optics, function-theoretic methods, gratings and frequently, inverse problems, lasers, linear accelerator models, nonlinear phenomena, open wavelengths, plasma and waves, radomes, remote sensing models, waveguide circuits, computer aided design, and more.
DTIC
*Conferences; Electromagnetism; Mathematical Models*

**20020018124** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Quasi-model-independent search for new high pT physics at DO**
Knuteson, B. O.; Dec. 11, 2000; 221p; In English
Report No.(s): DE2001-785255; LBNL-47185; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present a new quasi-model-independent strategy (”Sleuth”) for searching for physics beyond the standard model. We define final states to be studied, and construct a rule that identifies a set of relevant variables for any particular final state. A novel algorithm searches for regions of excess in those variables and quantifies the significance of any detected excess. This strategy is applied to search for new high p-T physics in approximately 100 pb-1 of proton-anti-proton collisions at sqrt(s) = 1.8 TeV collected by the D0 experiment during 1992-1996 at the Fermilab Tevatron. We systematically analyze many exclusive final states, and demonstrate sensitivity to a variety of models predicting new phenomena at the electroweak scale. No evidence of new high p-T physics is observed.
NTIS
*Particle Accelerators; Algorithms*

**20020018130** Brookhaven National Lab., Upton, NY USA
**Calibration of Photoelastic Modulators in the Vacuum UV**
Oakberg,; Trunk,; Sutherland,; Feb. 15, 2000; 12p; In English
Report No.(s): DE2001-785052; BNL-68548; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Measurements of circular dichroism (CD) in the ultraviolet (UV) and vacuum UV have used photoelastic modulators (PEMs) for high sensitivity (to about 10(exp 6)). While a simple technique for wavelength calibration of the PEMs has been used with good results, several features of these calibration curves have not been understood. The authors have calibrated a calcium fluoride PEM and a lithium fluoride PEM using the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory as a light source. These experiments showed calibration graphs that are linear bit do not pass through the graph origin. A second ’multiple pass’ experiment with laser light of a single wavelength, performed on the calcium fluoride PEM, demonstrates the linearity of the PEM electronics. This implies that the calibration behavior results from intrinsic physical properties of the PEM optical element material. An algorithm for generating calibration curves for calcium fluoride and lithium fluoride PEMs has been developed. The calibration curves for circular dichroism measurement for the two PEMs investigated in this study are given as examples.
NTIS
*Calcium Fluorides; Calibrating; Far Ultraviolet Radiation; Modulators*

**20020018134** Brookhaven National Lab., Upton, NY USA
**Two Stage Crystal Collimator for RHIC**
Fliller, R. P.; Drees,; Gassner,; Hammons,; McIntyre,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-785045; BNL-67967; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The use of a two stage crystal collimation system in the Relativistic Heavy Ion Collider (RHIC) yellow ring is examined. The system includes a copper beam scraper and a bent silicon crystal. While scrapers were installed in both of the RHIC rings before the year 2000 run, the crystal is installed for the run in one ring only, forming a two stage collimation system there. We present simulations of the expected channeling through the bent silicon crystal for both protons and gold ions with various beam parameters. This gives a picture of the particle losses around the ring, and the expected channeling efficiency. These results are

then used to optimize the beam parameters in the area of the crystal to obtain maximum channeling efficiency, minimize out-scattering in the secondary collimator, and reduce beam halo.
NTIS
*Collimation; Collimators; Crystals; Computerized Simulation*

**20020018139** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**CEBAF Beam Scraping Monitor**
Allison, T.; Lebedev, V.; Piller, C.; Sage, J.; Wiseman, M.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783619; JLAB-ACE-01-07; DOE/ER/40150-1872; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Beam Scraping Monitor (BSM) is used to detect small amounts of beam loss in Jefferson Lab's Continuous Electron Beam Accelerator Facility (CEBAF). The BSM acts as an early warning system that alerts CEBAF operators when the beam loss exceeds 10 to 20 nA. This allows the CEBAF operators to adjust the beam orbit before beam loss reaches the Beam Current Monitor (BCM) system threshold (presently 2 mu-A) and shuts down the accelerator. The reference oscillators of four digital signal processing (DSP) lock-in amplifiers are connected to two vertical and two horizontal corrector magnets in the CEBAF injector. These magnets excite transverse oscillations on the electron beam that are significantly smaller than the beam size, producing a negligible effect on beam delivery. to cover the entire accelerator enclosure, the correctors of each plane are separated by pi/2 betatron phase advance. When the electron beam approaches the beam enclosure some electrons get scraped off, causing an amplitude modulation of the beam current at the reference oscillator frequencies. This is picked up by the BCM cavities and relayed to the lock-in amplifiers for synchronous integrated detection. The lock-in amplifiers then transmit the scraping information serially to a LINUX computer running EPICS Portable Channel Access Server software.
NTIS
*Electron Beams; Linear Accelerators*

**20020018202** Stanford Linear Accelerator Center, CA USA
**Study of CP-violating Asymmetries in B Yields pi(+/-) pi(-/+,K (+/-)pi(-/+) Decays**
Olsen, J. D.; Jul. 30, 2001; 19p; In English
Report No.(s): DE2001-787204; SLAC-PUB-8929; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
No abstract available.
NTIS
*Asymmetry; Particle Decay; Storage Rings (Particle Accelerators); Kaons*

**20020018203** Stanford Linear Accelerator Center, CA USA
**Study of T and CP Violation in B(sup 0)-anti-B(Sup 0) Mixing with Inclusive Dilepton Events**
Yeche, C.; Jul. 30, 2001; 18p; In English
Report No.(s): DE2001-787202; SLAC-PUB-8927; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
No abstract available.
NTIS
*Leptons; Linear Accelerators; Mesons; Particle Theory*

**20020018514** Brookhaven National Lab., Upton, NY USA
**Cp Violation in k Decay from Lattice QCD, RIKEN BNL Research Center, RBRC and Particle Physics Seminar, Brookhaven National Laboratory, Upton, N.Y., July 26, 2001**
Blum,; Mawhineey,; Jul. 26, 2001; 72p; In English
Report No.(s): DE2001-785043; BNL-52634; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The RIKEN BNL Research Center (RBRC) was established in April 1997 at Brookhaven National Laboratory. It is funded by the 'Kagaku Kenkysho' (RIKJZN), the Institute of Physical and Chemical Research, of Japan. The Center is dedicated to the study of strong interactions, including hard quantum chromodynamics (QCD)/spin physics, lattice QCD and RHIC (Relativistic Heavy Ion Collider) physics through nurturing of a new generation of young physicists. The Director of RBRC is Professor T. D. Lee. The first years were dedicated to the establishment of a theory group. This has essentially been completed consisting of Fellows, Postdocs, and RHIC Physics/University Fellows, with an active group of consultants. The center also organizes an extensive series of workshops on specific topics in strong interactions with an accompanying series of published proceedings. In addition, a 0.6 teraflops parallel processor computer has been constructed and operational since August 1998. It was awarded the

Supercomputer 1998 Gordon Bell Prize for price performance. An active experimental group centered around the spin physics program at RHIC has subsequently also been established at RBRC.
NTIS
*Quantum Chromodynamics; Research Facilities*

**20020019815** Naval Postgraduate School, Monterey, CA USA
**Mine Drop Experiment (MIDEX)**
Gilless, Anthony F.; Sep. 2001; 151p; In English
Report No.(s): AD-A397088; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The Navy's Impact Burial Prediction Model (IMPACT 25) determines the amount of burial a mine experiences upon impacting the marine sediment. Impact burial calculations are derived primarily from the sediment characteristics and from the mine's two-dimensional air and water phase trajectories. Accurate burial prediction requires that the model's air and water phase trajectories reasonably mimic the objects true trajectory. IMPACT 25 assumes that the objects are cylindrical in shape and calculates the air and water phase trajectories entirely from momentum equations. In order to determine what effect a varying center of mass has on a mine's water phase trajectory, a Mine Drop Experiment was conducted. The experiment consisted of dropping three cylinders of various lengths into a pool where the trajectories were filmed from two angles. The controlled parameters were, the ratio of mine length to diameter, initial velocity, center of mass position and drop angle. Results indicate that center of mass position has the largest influence on the object's trajectory and that accurate trajectory modeling requires the inclusion of both momentum and moment equations.
DTIC
*Impact Prediction; Mines (Ordnance); Descent*

**20020020366** NASA Marshall Space Flight Center, Huntsville, AL USA
**Inertial Screening in Sedimentation**
Segre, P. N., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; APS Division of Fluid Dynamics 54th Meeting, 18-20 Nov. 2001, San Diego, CA, USA; Sponsored by American Physical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Using particle image velocimetry we have measured the sedimentation dynamics of non-Brownian spheres over a wide range of Reynolds numbers (Re) between 0.001 and 2.5. Particle velocity fluctuations about the mean settling velocity show large-scale correlations whose spatial extent and magnitude Delta V/V are independent of Re up to a critical value Re less than Re(sub c). For Re greater than Re(sub c) the fluctuations substantially diminish with increasing Reynolds number due to inertial screening of the long-range hydrodynamic interactions (HI). The onset of inertial affects is found to occur when the Oseen length l(sub o)=v/V becomes of order the correlation length. In the inertial regime, the velocity fluctuations follow -(Delta V/V)(sup 2) approaching ln(Re), in agreement with an integration of the (l/r) HI over a narrow region extending up to the Oseen length l(sub o). A simple "blob" model connects the measured correlation lengths to the magnitudes of the velocity fluctuations.
Author
*Particle Image Velocimetry; Reynolds Number; Sediments*

**20020020965** Naval Surface Warfare Center, Indian Head, MD USA
**Sensitivity Testing of Contaminated Surfaces to Establish Non-Reactivity Levels of HMX, TATB, HBNQ, NC, and Tetryl on Wood, Concrete, and Metal *Final Report***
Caris, Anne E.; Aug. 31, 2001; 32p; In English
Report No.(s): AD-A397279; IHTR-2373; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The downsizing and closing of military establishments have generated the need to eliminate potential hazards from facilities previously used to process energetic materials. Testing for contamination levels is an established practice; however, there are no established criteria for safe and acceptable levels of contamination of facilities. Small-scale sensitivity testing was performed to establish levels of contamination that would not exhibit reactions to normally executed construction practices. Standard friction, impact, and electrostatic discharge (ESD) sensitivity tests were used. Wood, concrete, and metal anvils and plates were prepared with a quantifiable amount of contaminant on the testing surfaces. The contaminants were HMX (cyclotetramethylentetranitramine), TATB (1,3,5-triamino- 2,4,6-trinitrobenzene), HBNQ (nitroguanidine), NC (nitrocellulose), and tetryl. Results are given.
DTIC
*Explosives; Electric Discharges; Sensitivity Analysis; Reactivity*

**20020021279** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**Study of Diffraction Effects at 60 GHz**
Holm, P.; Jan. 2000; ISSN 1104-9154; 34p; In English
Report No.(s): PB2002-100655; FOA-R-00-01446-504-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is a brief study of diffraction effects at 60 GHz. Diffraction examples in both two and three dimensions are shown. The results show expected rapid decreases in signal strengths when moving from the shadow boundaries into the shadow regions. The diffraction geometries used are quite simple and do not require any corner diffractions to be considered. In the connection, future improvements, of interest for other frequencies than 60 GHz also, are discussed, i.e., problems and advantages of an inclusion of corner diffractions, problems and advantages of a proper ray tracing routine in three dimensions, etc. Finally, diffraction by a transparent wedge is investigated in order to see if it is possible to use such wedges to model vegetation and especially forest. The investigation shows that transparent wedges can, to a certain extent, be used for vegetation modelling, but shows also on problems. In some situations, a transparent wedge seems to give a very doubtful result.
NTIS
*Diffraction; Radio Waves; Three Dimensional Models; Vegetation*

## 71
## ACOUSTICS

*Includes sound generation, transmission, and attenuation. For noise pollution see 45 Environment Pollution. For aircraft noise see also 02 Aerodynamics and 07 Aircraft Propulsion Propulsion and Power.*

**20020016489** NASA Ames Research Center, Moffett Field, CA USA
**Contrast Gain Control Model Fits Masking Data**
Watson, Andrew B., NASA Ames Research Center, USA; Solomon, Joshua A., NASA Ames Research Center, USA; [1994]; 1p; In English; Association for Research in Vision and Ophthalmology, 14-19 May 1995, Fort Lauderdale, FL, USA; Sponsored by Association for Research in Vision and Ophthalmology, USA
Contract(s)/Grant(s): RTOP 505-64-53; RTOP 199-06-12-31; No Copyright; Avail: Issuing Activity; Abstract Only

We studied the fit of a contrast gain control model to data of Foley (JOSA 1994), consisting of thresholds for a Gabor patch masked by gratings of various orientations, or by compounds of two orientations. Our general model includes models of Foley and Teo & Heeger (IEEE 1994). Our specific model used a bank of Gabor filters with octave bandwidths at 8 orientations. Excitatory and inhibitory nonlinearities were power functions with exponents of 2.4 and 2. Inhibitory pooling was broad in orientation, but narrow in spatial frequency and space. Minkowski pooling used an exponent of 4. All of the data for observer KMF were well fit by the model. We have developed a contrast gain control model that fits masking data. Unlike Foley's, our model accepts images as inputs. Unlike Teo & Heeger's, our model did not require multiple channels for different dynamic ranges.
Derived from text
*Computer Programs; Dynamic Range; Gabor Filters*

**20020016970** Massachusetts Inst. of Tech., Cambridge, MA USA
**Tracer Evolution at High Latitudes in Winter (SOLVE)** ***Final Report, 1 Jul. 1999 - 30 Sep. 2001***
Plumb, R. Alan, Massachusetts Inst. of Tech., USA; [2001]; 2p; In English
Contract(s)/Grant(s): NAG1-2203; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Prior to the SOLVE deployment, we modified and ran a chemical transport model (CTM) to set up a stratospheric climatology for 1 September 1999. During and immediately following the SOLVE deployments, we ran the model in near-real-time and used these results in conjunction with SOLVE observations to draw conclusions about stratospheric transport.
Author
*Climatology; Stratosphere; Polar Regions; Computerized Simulation*

**20020017762** Florida State Univ., Dept. of Mathematics, Tallahassee, FL USA
**Micro- and Macro-Fluid Dynamics and Acoustics of Resonant Liners** ***Final Report***
Tam, Christopher K. W., Florida State Univ., USA; [2002]; 3p; In English
Contract(s)/Grant(s): NAG1-1986; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objectives of this project are to perform direct numerical simulation of the micro-fluid and acoustic fields of a resonant acoustic liner and to investigate the physical processes by which incident sound waves are damped by the acoustic liner. We would like to report that our research work and results have fulfilled both objectives of the grant. The following is a summary of the

important accomplishments: (1) Two dimensional direct numerical simulation of the flow and acoustic field around the cavity of resonant liner were successfully carried out; (2) The simulations of (1) were extended to include a laminar grazing flow; (3) The numerical simulations provided strong evidence that there are two principal mechanisms by which a resonant liner damps out an incident acoustic wave; (4) A validation test was performed by comparing the computed dissipation coefficients (not impedance) with impedance tube measurements done at GTRI; and (5) Some resources of this grant were used to support the development of new CAA methods. (Our work on numerical simulation of acoustic liners has benefited by the availability of these improved methods).
Derived from text
*Direct Numerical Simulation; Fluid Dynamics; Impedance Measurement; Linings; Two Dimensional Models*

**20020018622** Southampton Univ., Fluid Dynamics and Acoustics Group, UK
**A Study of Virtual Acoustic Imaging Systems for Asymmetric Listener Locations**
Rose, J., Southampton Univ., UK; Nelson, P. A., Southampton Univ., UK; Rafaely, B., Southampton Univ., UK; Takeuchi, T., Southampton Univ., UK; November 2001; 48p; In English
Report No.(s): ISVR-TR-295; Copyright; Avail: Issuing Activity

Virtual acoustic imaging systems are effective when the listener's head location is close to the head location assumed when the system was designed. The sweet spot refers to the spatial bubble of head location in which the system is still effective. Previous work investigating the "stereo dipole" acoustic imaging system shows that for the traditional on-axis listener location the sweet spot is about +/- 5cm for lateral head translations. Larger head movements than this require an update of the virtual acoustic imaging filters. The interest here is the sweet spot size at off-axis asymmetric listener locations or an understanding of how often one needs to update the filters to ensure the listener perceives a stable virtual image as they move. The examination of the off-axis sweet spot size comprises a theoretical acoustic analysis, computer simulations, and a subjective study. The simulations and subjective evaluation both demonstrate that the width of tolerable lateral head translations is comparable for the symmetric on-axis listener location and asymmetric listener locations that are as far as 25cm off-axis.
Author
*Acoustic Imaging; Head Movement; Position (Location); Virtual Reality; Image Filters*

**20020018831** Technische Univ., Centre for Technical Geoscience, Delft, Netherlands
**Reflected and Transmitted Acoustic Field Excited by a Supersonic Source in a Two Media Configuration**
Kooij, B. J.; Kooij, C.; Sep. 1999; 24p; In English
Report No.(s): PB2002-100734; ET/EM-1999-16; Copyright; Avail: National Technical Information Service (NTIS)

The acoustic wave field due to a supersonic motion of a rigid object over a half-space is investigated. The research presented here is of great importance for the modeling of the transmitted and reflected conical waves that are excited by airplanes that fly over sea or land. The media involved are acoustically modeled as homogeneous, isotropic fluids and the moving object is represented as an acoustic source of the dipole type. The linearized acoustic field equations are applied to obtain representations for the fields in a combined Laplace-Fourier transform domain. to these representations, which are mapped into the proper form, we apply the Cagniard-de Hoop technique in order to find closed phenomena, like head waves and reflected and transmitted conical waves, come forward from the procedure as partial results with precursive fronts and clearly defined trailing edges. Numerical results for the reflected as well as the transmitted conical wave are presented.
NTIS
*Acoustics; Isotropy; Sound Generators; Supersonics; Mathematical Models*

**20020018877** Pennsylvania State Univ., Applied Research Lab., University Park, PA USA
**High Frequency Acoustics and Signal Processing for Weapons** ***Final Report, 1 Jan. 2000-31 Dec. 2001***
Bradley, David L.; Dec. 2001; 12p; In English; Original contains color images
Contract(s)/Grant(s): N00014-00-1-0138
Report No.(s): AD-A397044; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Determine, for a broad range of frequencies (nominally 10-100 kHz), the limitations imposed by the oceanic environment on the exploitation of coherent signal structure. This understanding is required in order to optimize sonar signal processing structures (e.g. channel conditioning, especially in shallow water), for wideband signal and processor design, and for acoustic propagation modeling. Develop the capability to predict the dynamic and spatial characteristics of wakes and the acoustic field behavior in and around the wakes of Navy warships. Seek a predictive capability for how acoustic propagation varies with

frequency, source receiver geometry relative to the wake, and the spatial statistics of attenuation and scattering strength in the wake.
DTIC
*Acoustics; Signal Processing; High Frequencies; Prediction Analysis Techniques; Dynamic Characteristics*

**20020019016** Mississippi Univ., Physical Acoustics Research Lab., University, MS USA
**Proceedings of the Resonance Meeting Held in the University of Mississippi on May 30-June 1, 1999. Volume 2. Transparencies**
Furr, Elizabeth A.; Jun. 04, 2001; 330p; In English; Original contains color images
Contract(s)/Grant(s): N00014-98-1-0033
Report No.(s): AD-A396978; LF1000-01; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche
The Proceedings of the Resonance Meeting held May 30 to June 1, 1999 are in two volumes. Volume I of the proceedings contains verbatim transcriptions of the presentations given. This volume also contains a special appendix honoring Orson L. Anderson, Harold H. Demarest, Jr. and Ichiro Ohno for their contributions to the development of resonance techniques for determining elastic properties of solids. Volume II of these proceedings contains copies of the transparencies used by the presenters.
DTIC
*Elastic Properties; Solids; Acoustic Resonance; Conferences*

**20020019043** National Defence Research Establishment, Div. of Systems and Underwater Technology, Stockholm, Sweden
**Modelling of a Target Strength Measurement System**
Hegethorn, J. O.; Moren, P.; Pihl, J.; Soederberg, P.; Staaf, O.; Oct. 2000; 18p; In English
Report No.(s): PB2002-100693; FOA-R-00-01635-409-SE; Copyright; Avail: National Technical Information Service (NTIS)
The performance of a sonar system for target strength measurements has been investigated by using the Mocassin model and a new empirical reverberation model. The Mocassin model, however, failed to correctly evaluate the system performance due to a too short detector-target distance compared to actual water depths. The empirical model, on the other hand, indicates that the system is reverberation limited for isotropic and omni directional antenna beam patterns. The result is that the target echo level is below the noise level, i.e. the system will not work as proposed. But by changing to an antenna with higher horizontal directivity and by using broadband signals the system might work.
NTIS
*Sonar; Mathematical Models; Targets; Beams (Radiation); Antenna Radiation Patterns*

**20020019078** Acoustical Society of America, New York, NY USA
**1st International Workshop Thermoacoustics**
Zeegers, J.; Schmid, C. E.; Apr. 25, 2001; 67p; In English, 22-25 Apr. 2001, Hertogenbosch, Netherlands
Report No.(s): AD-A396927; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The first theory of sound propagation which has fully accounted for the effects of heat conduction on the speed of sound was given by Kirchhoff in 1868. Starting with the energy equation for an ideal gas which was proposed in 1842 by the German physician Robert Mayers, Kirchhoff was first to formulate a version of this equation in which density fluctuations were the only non-thermal effects induced and thus the sole ”cause” of a correction to the Newtonian value of the sound speed which was initiated by Laplace in 1821. The linearization of this equation permitted its combination with the small-disturbance approximations of the equations of motion, and a theory of sound propagation was established.
DTIC
*Sound Transmission; Conductive Heat Transfer; Ideal Gas; Sound Propagation; Thermoacoustic Effects*

**20020019804** Pennsylvania State Univ., Applied Research Lab., University Park, PA USA
**Sub-Band Modulation in Active Sonar**
Boeker, Eric R.; Dec. 2001; 100p; In English; Original contains color images
Report No.(s): AD-A397201; TR-01-006; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche
A method for the simultaneous transmission of multiple sonar signals is described and investigated. The sonar signals are linearly combined as the modulating phase component of a carrier signal, which avoids the transmit energy losses in peak power limited systems caused by a modulating amplitude. These modulating signals are designed to be spectrally separable upon reception, so each sonar signal can be simultaneously processed. Demodulation and echo processing techniques are then presented, and several experiments (both simulated and in-water) were conducted to investigate the detection performance of the

modulated signals, as compared to the equivalent unmodulated signals. Results from these experiments indicate that the modulation technique is a viable method of transmitting multiple sonar signals simultaneously, while avoiding amplitude modulation.
DTIC
*Amplitude Modulation; Sonar; Multipath Transmission; Bandwidth*

**20020019842** Boeing Co., Long Beach, CA USA
**Structural Acoustic Prediction and Interior Noise Control Technology**
Mathur, G. P., Boeing Co., USA; Chin, C. L., Boeing Co., USA; Simpson, M. A., Boeing Co., USA; Lee, J. T., Boeing Co., USA; November 2001; 48p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS1-97040; RTOP 706-81-14-01
Report No.(s): NASA/CR-2001-211247; NAS 1.26:211247; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report documents the results of Task 14, "Structural Acoustic Prediction and Interior Noise Control Technology". The task was to evaluate the performance of tuned foam elements (termed Smart Foam) both analytically and experimentally. Results taken from a three-dimensional finite element model of an active, tuned foam element are presented. Measurements of sound absorption and sound transmission loss were taken using the model. These results agree well with published data. Experimental performance data were taken in Boeing's Interior Noise Test Facility where 12 smart foam elements were applied to a 757 sidewall. Several configurations were tested. Noise reductions of 5-10 dB were achieved over the 200-800 Hz bandwidth of the controller. Accelerometers mounted on the panel provided a good reference for the controller. Configurations with far-field error microphones outperformed near-field cases.
Author
*Aircraft Noise; Acoustic Attenuation; Mathematical Models; Technology Utilization; Controllers; Aircraft Structures*

**20020021281** National Defence Research Establishment, Div. of Systems and Underwater Technology, Stockholm, Sweden
**Positioning in a Wideband Synthetic Aperture Sonar Field Experiment**
Joensson, M.; Aug. 2000; ISSN 1104-9154; 40p; In English
Report No.(s): PB2002-100643; FOA-R-00-01575-409-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This thesis describes the processing from a wideband synthetic aperture experiment using a uniform linear array sonar. In synthetic aperture processing a small antenna is used to simulate a large antenna. Signals from several positions are combined to synthesize and signal received with a large antenna. If the synthetic aperture method is correct the image resolution depends on the positioning accuracy of the sonar. The image method has been proven to work in previous experiments when the sonar was moved on a fixed rail. In the present experiments a remotely operated vehicle carried the sonar. The vehicle position was determined from two stationary beacons on the sea floor, while instruments on the vehicle measured vehicle depth. The digitalized acoustic signals were matched-filtered by a calibrating kernel in an attempt to equalize response for all the sonar receiver channels. The direction of arrival was estimated by iterative MUSIC. Range was estimated by measuring the time-delay to the peak, or correlating the received and match-filtered signals with a matched-filtered replica of the transmitted pulse. The vehicle's position could then be determined by triangulation. SAS images from the experiments are shown and software improvements described.
NTIS
*Broadband; Positioning; Sonar; Synthetic Apertures; Image Processing; Signal Transmission*

## 72
## ATOMIC AND MOLECULAR PHYSICS

*Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see 73 Nuclear Physics.*

**20020016122** Princeton Univ., Plasma Physics Lab., NJ USA
**Simulations of Electron Transport in Laser Hot Spots**
Brunner, S.; Valeo, E.; Aug. 30, 2001; 47p; In English
Report No.(s): DE2001-787905; PPPL-3599; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Simulations of electron transport are carried out by solving the Fokker-Planck equation in the diffusive approximation. The system of a single laser hot spot, with open boundary conditions, is systematically studied by performing a scan over a wide range of the two relevant parameters: (1) Ratio of the stopping length over the width of the hot spot. (2) Relative importance of the heating through inverse Bremsstrahlung compared to the thermalization through self-collisions. As for uniform illumination, the bulk of

the velocity distribution functions (VDFs) present a super-Gaussian dependence. However, as a result of spatial transport, the tails are observed to be well represented by a Maxwellian. A similar dependence of the distributions is also found for multiple hot spot systems. For its relevance with respect to stimulated Raman scattering, the linear Landau damping of the electron plasma wave is estimated for such VDFs. Finally, the nonlinear Fokker-Planck simulations of the single laser hot spot system are also compared to the results obtained with the linear non-local hydrodynamic approach, thus providing a quantitative limit to the latter method: The hydrodynamic approach presents more than 10% inaccuracy in the presence of temperature variations of the order delta T/T greater than or equal to 1%, and similar levels of deformation of the Gaussian shape of the Maxwellian background.
NTIS
*Lasers; Electron Transfer; Hot Electrons; Velocity Distribution; Electron Plasma*

**20020016201** Brookhaven National Lab., Upton, NY USA
**Use of thin scrapers for momentum collimation**
CatalanLasheras,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783179; BNL-68042; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In transverse collimation systems, thin scrapers are used as primary collimators to interact with the beam halo and increase its impact parameter on the secondary collimators or absorbers. In the same way, placing the primary collimator in a dispersion region is used for momentum collimation. However, the use of scrapers for momentum collimation presents an additional disadvantage when handling medium-low energy beams. The energy lost by ionization is non negligible and the proton can be kicked out of the RF (radio frequency) bucket. The material and thickness of the scraper have to be carefully adjusted according to the position of secondary collimators and momentum aperture of the machine. We derive simple analytical expressions for a generic case. The same calculations have been applied to the case of the SNS (Spallation Neutron Source) accumulator ring. After careful considerations, the use of scrapers for momentum collimation was ruled out in favor of a beam in gap kicker system.
NTIS
*Collimation; Proton Beams; Ionization; Energy Dissipation; Collimators*

**20020016214** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Unique electron polarimeter comparison and spin-based energy measurement**
Grames, J. M.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783611; JLAB-ACC-01-12; DOE/ER/40150-1864; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A careful intercomparison of the relative analyzing power of five electron beam polarimeters was performed at Jefferson Lab during a dedicated two day machine development period. This is the first time such a comparison between Mott, Compton, and Moller polarimeters has been made. A Wien-style spin manipulator at the injector was used to vary the spin orientation of the electron beam at each polarimeter. A series of measurements as a function of spin orientation provides determination of the relative analyzing power of each polarimeter, and more importantly, quantifies the instrumental systematics which help realize high precision absolute electron polarimetry. In addition, a comparison of the value of the injector spin angle that. provides precise longitudinal beam polarization at each experimental hall leads to an independent and potentially high precision measurement (dE/E = 10-5) of the final electron beam energy. Results and discussion of the tests of the polarimeters and energy measurement will be presented.
NTIS
*Polarimeters; Manipulators; Electron Spin; Spin Resonance*

**20020016221** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Status of neutrino factory and muon collider R and D**
Zisman, M. S.; Jun. 17, 2001; 5p; In English
Report No.(s): DE2001-783484; LBNL-47302; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A significant worldwide R and D effort is presently directed toward solving the technical challenges of producing, cooling, accelerating, storing, and eventually colliding beams of muons. Its primary thrust is toward issues critical to a Neutrino Factory, for which R and D efforts are under way in the U.S., via the Neutrino Factory and Muon Collider Collaboration (MC); in Europe, centered at CERN; and in Japan, at KEK. Under study and experimental development are production targets handling intense proton beams (1-4 MW), phase rotation systems to reduce beam energy spread, cooling channels to reduce transverse beam emittance for the acceleration system, and storage rings where muon decays in a long straight section provide a neutrino beam for a long-baseline (3000 km) experiment. Critical experimental activities include development of very high gradient normal conducting RF (NCRF) and superconducting RF (SCRF) cavities, high-power liquid-hydrogen absorbers, and high-field

superconducting solenoids. Components and instrumentation that tolerate the intense decay products of the muon beam are being developed for testing. For a high-luminosity collider, muons must be cooled longitudinally as well as transversely, requiring an emittance exchange scheme. In addition to the experimental R and D effort, sophisticated theoretical and simulation tools are needed for the design. Here, the goals, present status, and future R and D plans in these areas will be described.
NTIS
*Neutrino Beams; Muons; Research and Development*

**20020016234** Fermi National Accelerator Lab., Batavia, IL USA
**30 years of high-intensity negative ion sources for accelerators**
Dudnikov, V.; Jul. 25, 2001; 3p; In English
Report No.(s): DE2001-783407; FERMILAB-CONF-01/204; No Copyright; Avail: Department of Energy Information Bridge
Thirty years ago, July 1, 1971, significant enhancement of negative ion emission from a gas discharge following an admixture of cesium was observed for the first time. This observation became the basis for the development of Surface Plasma Sources (SPS) for efficient production of negative ions from the interaction of plasma particles with electrodes on which adsorbed cesium reduced the surface work-function. The emission current density of negative ions increased rapidly from j (approximately) 10 mA/square cm to 3.7 A/square cm with a flat cathode and up to 8 A/square cm with an optimized geometrical focusing in the long pulse SPS, and to 0.3 A/square cm for DC SPS, recently increased up to 0.7 A/square cm. Discovery of charge-exchange cooling helped decrease the negative ion temperature T below 1 eV, and increase brightness by many orders to a level compatible with the best proton sources, B = j (approximately) 1 A/square cm eV. The combination of the SPS with charge-exchange injection improved large accelerators operation and has permitted beam accumulation up to space-charge limit and overcome this limit several times. The early SPS for accelerators have been in operation without modification for (approximately) 25 years. Advanced version of the SPS for accelerators is described. Features of negative ion beam formation, transportation, space-charge neutralization-overneutralization, and instability damping is considered. Practical aspects of SPS operation and high brightness beam production is discussed.
NTIS
*Particle Accelerators; Ion Sources; Negative Ions*

**20020016284** Princeton Univ., Plasma Physics Lab., NJ USA
**Neutral Beam Ion Confinement in NSTX**
Darrow, D. S.; Fredrickson, E. D.; Kaye, S. M.; Medley, S. S.; Roquemore, A. L.; Jul. 24, 2001; 8p; In English
Report No.(s): DE2001-787786; PPPL-3593; No Copyright; Avail: Department of Energy Information Bridge
Neutral-beam (NB) heating in the National Spherical Torus Experiment (NSTX) began in September 2000 using up to 5 MW of 80 keV deuterium (D) beams. An initial assessment of beam ion confinement has been made using neutron detectors, a neutral particle analyzer (NPA), and a Faraday cup beam ion loss probe. Preliminary neutron results indicate that confinement may be roughly classical in quiescent discharges, but the probe measurements do not match a classical loss model. MHD activity, especially reconnection events (REs) causes substantial disturbance of the beam ion population.
NTIS
*Ion Beams; Neutral Beams; Heating*

**20020016287** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Deuteron: A mini-review**
Gross, F.; Gilman, R.; Jul. 01, 2001; 14p; In English
Report No.(s): DE2001-787756; JLAB-PHY-01-23; DOE/ER/40150-1916; WM-01-112; No Copyright; Avail: Department of Energy Information Bridge
We review some recent results for elastic electron deuteron scattering (deuteron form factors) and photodisintegration of the deuteron, with emphasis on the recent high energy data from Jefferson Laboratory (JLab).
NTIS
*Elastic Scattering; Deuterons; Sweep Frequency*

**20020016355** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Spin Physics at JLAB in the Resonance Region**
Burkert, V.; May 01, 2001; 10p; In English
Report No.(s): DE2001-784646; JLAB-PHY-01-19; DOE/ER/40150-1896; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

I will discuss recent results from Jefferson Lab on the measurement of inclusive spin structure functions in the nucleon resonance region using polarized ammonia NH(sub 3) and polarized (sup 3)He targets. Preliminary results on the first moment of g(sub 1)(x,Q(sub 2)) for protons, and the generalized Gerasimov-Drell-Hearn integral for neutrons are presented. In addition, first double polarization data on exclusive electroproduction of pi(+) for polarized protons will be discussed.
NTIS
*Spin; Ammonia; Nucleons*

**20020016365** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Performance of the CEBAF Arc Beam Position Monitors**
Hofler, A. S.; Bowling, B. A.; Higgins, C. S.; Kloeppel, P. K.; Krafft, G. A.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787851; CEBAF-PR-93-038; DOE/ER/40150-1922; No Copyright; Avail: Department of Energy Information Bridge
The first three quarters of the first CEBAF arc have been instrumented with beam position monitors. Thirty-seven monitors (of 450) have been installed and their noise measured. Resolution of 100 mu-m was obtained at the lowest operating current of 1 mu-A. The update time of the system is 1 sec, limited by computer interfacing with a potential bandwidth of greater than 10 kHz.
NTIS
*Performance Prediction; Particle Accelerators; Beams (Radiation); Monitors*

**20020016367** Fermi National Accelerator Lab., Batavia, IL USA
**Highly improved naive and staggered fermions**
Trottier, H. D.; Oct. 23, 2001; 3p; In English
Report No.(s): DE2001-787848; No Copyright; Avail: Department of Energy Information Bridge
Naive and staggered fermion actions (which have very similar properties) have numerous advantages over actions based on four-component Wilson fermions. They have an exact chiral symmetry, allowing a simpler approach to the light-quark limit. They require only even dimension correction operators, simplifying the improvement program. Staggered fermion propagators can be calculated much more rapidly than Wilson fermion propagators.
NTIS
*Fermions; Symmetry; Chirality*

**20020016368** Fermi National Accelerator Lab., Batavia, IL USA
**Charm quark mass to two-loop order**
Juge, K. J.; Oct. 23, 2001; 3p; In English
Report No.(s): DE2001-787843; No Copyright; Avail: Department of Energy Information Bridge
Precision calculation of the standard model parameters is one the goals of lattice QCD. The determination of the charm quark mass, however, remained a difficulty as a am(sub 0) approx. 1.
NTIS
*Quarks; Computation; Loops*

**20020016370** Fermi National Accelerator Lab., Batavia, IL USA
**E1 Working Group Summary: Neutrino factories and muon colliders**
Adams, T.; Oct. 23, 2001; 24p; In English
Report No.(s): DE2001-787841; No Copyright; Avail: Department of Energy Information Bridge
The experimental study of the fundamental properties of neutrinos is one the most challenging in particle physics, but it has also produced some of the most exciting and revolutionary physics insights, both on microscopic and astrophysical scales. The discovery of the electron neutrino emitted in beta decay in the 1950s confirmed the hypothesis in the early 1930s by Pauli and Fermi of the existence of the electron neutrino. Shortly thereafter its left-handed nature was confirmed, the muon neutrino was discovered, and oscillations among three neutrino flavors were predicted. Neutrino neutral currents were pivotal in the confirmation of the Standard Model in the 1970s. The number of active neutrino flavors was measured to be three by the LEP experiments and by SLD. However, despite immense experimental efforts, discovery of neutrino mass and flavor mixing remained beyond reach until deep underground experiments were carried out to observe neutrinos of extra-terrestrial origins. The study of the fundamental properties of neutrinos is now major discovery phase. There are good reasons to expect important neutrino discoveries to continue through the next two decades using new accelerator based neutrino sources, as will be summarized in this

report. The rich new physics that can be explored will test the most basic tenets of particle theory: the masses and mixing of fermions and CO violation.
NTIS
*Muons; Neutrinos; Particle Acceleration; Emittance*

**20020016371** Brookhaven National Lab., Upton, NY USA
**Report of the Snowmass M6 Working Group on High Intensity Proton Sources**
Chou,; Wei,; Aug. 14, 2001; 36p; In English
Report No.(s): DE2001-787832; BNL-52639; No Copyright; Avail: Department of Energy Information Bridge
The M6 working group had more than 40 active participants (listed in Section 4). During the three weeks at Snowmass, there were about 50 presentations, covering a wide range of topics associated with high intensity proton sources. The talks are listed in Section 5. This group also had joint sessions with a number of other working groups, including E1 (Neutrino Factories and Muon Colliders), E5 (Fixed-Target Experiments), M1 (Muon Based Systems), T4 (Particle Source), T5 (Beam dynamics). T7 (High Performance Computing) and T9 (Diagnostics).
NTIS
*Particle Beams; Linear Accelerators; Protons*

**20020016376** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**High flux compact neutron generators**
Reijonen, J.; Lou, T. P.; Tolmachoff, B.; Leung, K. N.; Verbeke, J.; Jun. 15, 2001; 4p; In English
Report No.(s): DE2001-783489; LBNL-47375; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Compact high flux neutron generators are developed at the Lawrence Berkeley National Laboratory. The neutron production is based on D-D or D-T reaction. The deuterium or tritium ions are produced from plasma using either a 2 MHz or 13.56 MHz radio frequency (RF) discharge. RF-discharge yields high fraction of atomic species in the beam which enables higher neutron output. In the first tube design, the ion beam is formed using a multiple hole accelerator column. The beam is accelerated to energy of 80 keV by means of a three-electrode extraction system. The ion beam then impinges on a titanium target where either the 2.4 MeV D-D or 14 MeV D-T neutrons are generated. The MCNP computation code has predicted a neutron flux of approximately 10(exp 11) n/s for the D-D reaction at beam intensity of 1.5 A at 150 kV. The neutron flux measurements of this tube design will be presented. Recently new compact high flux tubes are being developed which can be used for various applications. These tubes also utilize RF-discharge for plasma generation. The design of these tubes and the first measurements will be discussed in this presentation.
NTIS
*Ions; Particle Production; Flux (Rate); Neutrons; Deuterium*

**20020016378** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Progress with the SNS front-end systems**
Keller, R.; Abraham, W.; Ayers, J. J.; Cheng, D. W.; Cull, P.; May 01, 2001; 3p; In English
Report No.(s): DE2001-783486; LBNL-47317; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The Front-End Systems (FES) of the Spallation Neutron Source (SNS) project have been described in detail elsewhere. They comprise an rf-driven H(sup -) ion source, electrostatic LEBT, four-vane RFQ, and an elaborate MEBT. These systems are planned to be delivered to the SNS facility in Oak Ridge in June 2002. This paper discusses the latest design features, the status of development work, component fabrication and procurements, and experimental results with the first commissioned beamline elements.
NTIS
*Neutron Sources; Spallation; Radio Frequencies; Ion Sources*

**20020016390** Fermi National Accelerator Lab., Batavia, IL USA
**Some Features of Transverse Instability of Partly Compressed Protons Beams**
Dudnikov, V.; Oct. 23, 2001; 4p; In English
Report No.(s): DE2001-787847; No Copyright; Avail: Department of Energy Information Bridge
Suppression of generation and accumulation of secondary particles is a traditional method for suppression the transverse electron-proton instability: improve the vacuum, use a gap in beam for electron removing, use cleaning electrodes, suppressing secondary emission. But opposite solution is also possible. Transverse e-p instability in proton rings can be damped by increasing beam density and the rate of secondary particles generation above a threshold level, with decrease of the unstable wavelength

below a transverse beam size. In high current Proton Storage Rings (PSR) such as, the LANSCE PSR it is possible to reach this island of stability by multiturn, concentrated charge exchange injection without painting and by enhanced generation of secondary plasma.
NTIS
*Proton Beams; Transverse Acceleration; Charge Exchange; Stability*

**20020016392** Fermi National Accelerator Lab., Batavia, IL USA
**CDF Results on Diffraction from Run I and Plans for Run II**
Goulianos, K.; Oct. 16, 2001; 10p; In English
Report No.(s): DE2001-787693; No Copyright; Avail: Department of Energy Information Bridge
Results on soft and hard diffraction obtained by the Computational Fluid Dynamics (CFD) Collaboration in Run 1 of the Fermilab Tevatron (bar p)p collider are reviewed and compared with results from the DESY electron-proton collider HERA and with theoretical expectations. In addition, the CDF program for diffractive studies in Run 2 is briefly reviewed with emphasis on the relevant detector upgrades and physics goals.
NTIS
*Computational Fluid Dynamics; Diffraction; Elementary Particle Interactions; Proton-Antiproton Interactions*

**20020016402** Fermi National Accelerator Lab., Batavia, IL USA
**Muon cooling R and D**
Geer, S.; Aug. 22, 2001; 8p; In English
Report No.(s): DE2001-784605; FERMILAB-CONF-01/240-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
International efforts are under way to design and test a muon ionization cooling channel. The present R and D program is described, and future plans outlined.
NTIS
*Cooling Systems; Muons; Cooling*

**20020016453** Fermi National Accelerator Lab., Batavia, IL USA
**High Current Density Negative Ion Source for Beam Line Transport Study**
Dudnikov, V.; Schmidt, C. W.; Wendt, J.; Jul. 25, 2001; 3p; In English
Report No.(s): DE2001-783393; FERMILAB-CONF-01/205; No Copyright; Avail: Department of Energy Information Bridge
The Fermilab Electron Cooling Program requires a 20-m solenoidal region to interact 8-GeV antiprotons with an escorting beam of 4.3-MeV electrons to improve the phase-space quality of the antiproton beam. The solenoidal section with additional transport lines to take and return a 0.5-A electron beam from an electrostatic accelerator, for energy recovery, must be precisely aligned and adjusted. For the initial setup and study, and later testing of this line, a 12.4-keV H(-) beam can be used to simulate the 4.3 MeV electron beam. For this purpose a high-brightness H(-) ion source has been developed and tested. The source, a semiplanatron type, with a hollow cathode discharge and spherical cathode focusing of the emitted ions to the emission aperture has given an emission current density up to 0.7 A/sq cm. Continuous operation of four weeks has been demonstrated. Such an optimized source could have many applications for tandem accelerators, ion beam lithography and ion implantation.
NTIS
*Current Density; Ion Beams; Ion Sources; Negative Ions*

**20020016470** NASA Ames Research Center, Moffett Field, CA USA
**The Study of the Successive Metal-Ligand Binding Energies for Fe(sup +), Fe(sup -), V(sup +) and Co(sup +)**
Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; Ricca, Alessandra, NASA Ames Research Center, USA; Maitre, Philippe, NASA Ames Research Center, USA; [1995]; 1p; In English, 11 May 1995, GA, GA, USA, USA
Contract(s)/Grant(s): RTOP 232-01-04; No Copyright; Avail: Issuing Activity; Abstract Only
The successive binding energies of CO and H2O to Fe(sup +), CO to Fe(sup -), and H2 to Co(sup +) and V(sup +) are presented. Overall the computed results are in good agreement with experiment. The trends in binding energies are analyzed in terms of metal to ligand donation, ligand to metal donation, ligand-ligand repulsion, and changes in the metal atom, such as hybridization, promotion, and spin multiplicity. The geometry and vibrational frequencies are also shown to be directly affected by these effects.
Author
*Nuclear Binding Energy; Hydrogen; Water; Cobalt; Vanadium; Iron*

**20020016488** NASA Ames Research Center, Moffett Field, CA USA

**The Low-Lying Electronic States of LiB**

Ricca, Alessandra, NASA Ames Research Center, USA; Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; [1995]; 1p; In English

Contract(s)/Grant(s): RTOP 232-01-04; No Copyright; Avail: Issuing Activity; Abstract Only

The spectroscopic constants for the triplet and singlet states of LiB below about 30 000/ cm are determined using an internally contracted multireference configuration interaction approach in conjunction with [6s 5p 3d 2f] atomic natural orbital basis sets. The ground state is (sup 3)Pi as found in previous work. No excited triplet states are found to be ideal for characterizing the ground state; the (1)(sup 3)Sigma(sup -) state has a transition energy that is too small for many experimental approaches and the (2)(sup 3)Pi and (3)(sup 3)Pi states have bond lengths that are significantly longer than the ground state, resulting in transition intensities that are spread out over many vibrational levels of the ground state.

Author

*Lithium Borates; Electron States; Spectroscopy; Atomic Energy Levels*

**20020016490** NASA Ames Research Center, Moffett Field, CA USA

**A Study of the X(sup 2) Sigma(sup +) and A(sup 2) Pi States of MgAr(sup +) and MgKr(sup +)**

Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; Partridge, Harry, NASA Ames Research Center, USA; [1995]; 1p; In English

Contract(s)/Grant(s): RTOP 232-01-04; No Copyright; Avail: Issuing Activity; Abstract Only

The ground (sup 2)Sigma(sup +) and lowest excited (sup 2)Pi states of MgAr(sup +) and MgKr(sup +) are studied using the singles and doubles configuration interaction (SDCI) approach, in conjunction with large basis sets. The effect of Mg core correlation and core polarization are accounted for using the core-polarization potential (CPP) approach. Franck-Condon factors, oscillator strengths, radiative lifetimes, dissociation energies, bond lengths, and excitation energies are reported. The computed results are in good agreement with the available experimental data.

Author

*Magnesium Compounds; Argon; Krypton; Excitation*

**20020016655** Fermi National Accelerator Lab., Batavia, IL USA

**Recent Results from KTeV**

Bellantoni, L.; Aug. 02, 2001; 4p; In English

Report No.(s): DE2001-783916; FERMILAB-CONF-01/220-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent results are presented for: (1) the charge asymmetry in semielectronic kaon decay; (2) the charge radius of the neutral kaon; (3) the decay K(sub L)(sup 0) (r-arrow) (pi)(sup 0)(pi)(sup 0)e(sup +)e(sup (minus)); (4) constraints on (rho)(sub CKM) from kaon decays; (5) lepton flavor violation. A few words about future kaon physics work at Fermilab are included.

NTIS

*Leptons; Particle Decay*

**20020016671** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Sample chambers with mother-daughter mode**

Wilk, P. A.; Gregorich, K. E.; Hoffman, D. C.; Jul. 12, 2001; 5p; In English

Report No.(s): DE2001-785302; LBNL-48011; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A set of eight stand-alone sample chambers with a common interface were constructed at LBNL for improved detection of alpha and fission decay chains over currently used designs. The stainless steel chambers were constructed to allow for low background detection of a daughter event by removal of the sample following the detection of a parent event. This mother-daughter mode of operation has been utilized successfully with our Merry-go-Round (MG) detection system (Gregorich 1994).

NTIS

*Alpha Decay; Neutrons; Fission; Detection*

**20020016695** Brookhaven National Lab., Upton, NY USA

**Long-Range Interactions of Small Color Dipoles**

Fujii,; Kharzeev,; Apr. 16, 1998; 7p; In English

Report No.(s): DE2001-783988; BNL-68439; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We study the scattering of small color dipoles (e.g., heavy quarkonium states) at low energies. We find that even though the couplings of color dipoles to the gluon field can be described in perturbation theory, at large distances the interaction becomes totally non-perturbative. The structure of the scattering amplitude, however, is fixed by the (broken) chiral and scale symmetries of QCD; the leading long-distance contribution arises from the correlated two-pion exchange. We use the spectral representation technique to evaluate both perturbative and non-perturbative contributions to the scattering amplitude. Our main result is the sum rule which relates the overall strength of the non-perturbative interaction between color dipoles to the energy density of QCD vacuum.
NTIS
*Gluons; Scattering Amplitude; Particle Interactions*

**20020016867** Stanford Linear Accelerator Center, CA USA
**Using kaon regeneration to probe the quark mixing parameter cos(2 (beta)) in B Yields psi K decays**
Schietinger, T.; Jul. 26, 2001; 4p; In English
Report No.(s): DE2001-787175; SLAC-PUB-8550; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We suggest a novel method to determine the sign of cos 2 beta in the decays b psi K, by creating interference between KL and Ks final states via regeneration, that is propagation through a matter target region to convert some KL to Ks. The determination of this quantity resolves and ambiguity between Beta and 90 - Beta that remains after the standard measurements of sin 2 Beta and may turn out to be important in resolving whether the result is in agreement with Standard Model predictions or indicates the presence of new physics. We find the measurement is feasible at a B-factory, but requires several years of high-luminosity running with a regeneration target affecting a significant fraction of the detector.
NTIS
*Quarks; Mixing; Kaons*

**20020016868** Stanford Linear Accelerator Center, CA USA
**Implications of the Possibility that sin(2 (beta)) is Small**
Silva, J. P.; Jul. 26, 2001; 3p; In English
Report No.(s): DE2001-787174; SLAC-PUB-8548; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Recently, the Babar and Belle collaborations have reported their first measurements of the CP-violating asymmetry in Bd psi Ks, and more precise results will follow soon. We discuss what a future evidence for small sin 2 beta could mean, contrasting the usual possibility of new physics in the B(sub d) system, with the interesting alternative that the new physics effects are confined to the kaon system.
NTIS
*Kaons; Asymmetry*

**20020017456** NASA Ames Research Center, Moffett Field, CA USA
**The Theoretical Transition Probabilities Between the B(sup 3)Pi(sub g) and the A(sup 3)Sigma(Sup +, sub u), W(sup 3)Delta(sub u), B'(sup 3)Sigma(sup -, sub u) States of N2**
Thuemmel, Helmar T., NASA Ames Research Center, USA; Partridge, Harry, NASA Ames Research Center, USA; Huo, Winifred M., NASA Ames Research Center, USA; [1995]; 1p; In English
Contract(s)/Grant(s): RTOP 242-80-01; No Copyright; Avail: Issuing Activity; Abstract Only
The electronic transition moment functions between the B(sup 3)Pi(sub g) and the A(sup 3)Sigma(sup +, sub u), W(sup 3)Delta(sub u), B'(sup 3)Sigma(sup -, sub u) states of N2 are studied using the internally contracted multireference configuration interaction (ICMRCI) method based upon complete active space SCF (CASSCF) reference wave-functions. The dependence of the moments on both the one and n-particle basis sets has been investigated in detail. The calculated radiative lifetimes for the vibrational levels of B(sup 3)Pi(sub g) are in excellent agreement with the most recent measurement of Euler and Pipkin (1983) Author
*Numerical Analysis; Transition Probabilities; Electron Transitions*

**20020017931** Stanford Linear Accelerator Center, CA USA
**Observation of CP Violation in the B(sup 0) Meson System**
MacFarlane, D. B.; Jul. 25, 2001; 8p; In English
Report No.(s): DE2001-787193; SLAC-PUB-8904; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present an updated measurement of time-dependent CP-violating asymmetries in neutral B decays with the BABAR detector at the PEP-II asymmetric B Factory at SLAC. This result uses an additional sample of Upsilon(4S) decays collected in 2001, bringing the data available to 32 million B bar B pairs.
NTIS
*Mesons; Charm (Particle Physics); Standard Model (Particle Physics); Particle Decay*

**20020017934** Stanford Linear Accelerator Center, CA USA
**Experimental Status of Photon Photon into Baryon Antibaryon Pairs**
Barillari, T.; Jul. 26, 2001; 7p; In English
Report No.(s): DE2001-787190; SLAC-PUB-8878; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The application of QCD to exclusive two-photon reactions is based on the work of Brodsky and Lapage. According to their formalism the process is factorized into a non-perturbative part, the hadronic wave function of the final state, and a perturbative part. A calculation based on this ansatz uses a specific model of the proton's three-quark wave function by Chernyak and Zhitnitnitsky. This calculation predicts cross-sections that are about one order of magnitude smaller than the existing experimental results, for two-photon center-of-mass energies W greater than 2.5 GeV.
NTIS
*Photons; Baryons; Particle Collisions*

**20020017939** Stanford Linear Accelerator Center, CA USA
**Measurement of J/psi Production in Continuum e(+)e( -) Annihilations Near sqrt(s) = 10.6 GeV**
Hearty, C.; Jul. 25, 2001; 8p; In English
Report No.(s): DE2001-787185; SLAC-PUB-8854; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The development of non-relativistic QCD (NRQCD) represents a significant advance in the theory of the production of heavy quarkonium (qq) states. In particular, it provides an explanation for the cross section for psi (2S) production observed by CDF, which is a factor of 30 larger than expected from previous models. The enhancement is attributed to the production of a cc pair in a color octet state, which then evolves into the charmonium (cc) meson along with other light hadrons. A similar contribution is expected in NRQCD for J psi production in e(+)e(-) annihilation, but is absent in the color singlet model.
NTIS
*Mesons; Annihilation Reactions*

**20020017940** Stanford Linear Accelerator Center, CA USA
**Measurement of the B(sup 0) and B(+) Meson Lifetimes with Fully Reconstructed Hadronic Final States**
MacFarlane, D. B.; Aug. 13, 2001; 8p; In English
Report No.(s): DE2001-787184; SLAC-PUB-8847; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The B(sup 0) and B(sup +) meson lifetimes have been measured in e(sup +)e(sup -) annihilation data collected in 1999 and 2000 with the BABAR detector at center-of-mass energies near the Upsilon(4S) resonance. Events are selected in which one B meson is fully reconstructed in a hadronic final state while the second B approx. meson is reconstructed inclusively.
NTIS
*Mesons; Particle Collisions*

**20020017969** Stanford Linear Accelerator Center, CA USA
**Measuring the Photon Polarization in Radiative B Yields K-pi-pi-gamma**
Gronau, M.; Aug. 13, 2001; 10p; In English
Report No.(s): DE2001-787197; SLAC-PUB-8919; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We propose a way of measuring the photon polarization in radiative B decays into K resonance states decaying to K pi pi, which can test the Standard Model and probe new physics. The photon polarization is shown to be measured by the up-down asymmetry of the photon direction relative to the K pi pi decay plane in the K resonance rest frame. The integrated asymmetry in K1(1400) K pi pi, calculated to be 0.25, is measurable at currently operating B factories.
NTIS
*Meson Resonance; Photons; Particle Theory; Polarized Radiation*

**20020018020** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Properties of Group Five and Group Seven transactinium elements**

Wilk, P. A.; May 01, 2001; 108p; In English

Report No.(s): DE2001-785268; LBNL-47475; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The detection and positive identification of the short-lived, low cross section isotopes used in the chemical studies of the heaviest elements are usually accomplished by measuring their alpha-decay, thus the nuclear properties of the heaviest elements must be examined simultaneously with their chemical properties. The isotopes Pa-224 and Bh-266 and Bh-267 have been studied extensively as an integral part of the investigation of the heaviest members of the groups five and seven of the periodic table. The half-life of Pa-224 was determined to be 855 +/- 19 ms by measuring its alpha-decay using our rotating wheel, solid state detector system at the Lawrence Berkeley National Laboratory 88-Inch Cyclotron. Protactinium was produced by bombardment of a bismuth target. New neutron rich isotopes, Bh-267 and Bh-266, were produced in bombardments of a Bk-249 target and their decay was observed using the rotating wheel system. The Bh-266 that was produced decays with a half-life of approximately 1 s by emission of alpha particles with an average energy of 9.25 +/- 0.03 MeV. 267 Bh was observed to decay with a 17 s half-life by emission of alpha-particles with an average energy of 8.83 +/- 0.03 MeV. The chemical behavior of hahnium, Ha (element 105) was investigated using the fast on-line continuous liquid extraction and detection system SISAK-LISSY. Hahnium was not observed in this experiment following transport and extraction. Protactinium was used as on-line test of the apparatus to determine the experimental efficiency of the entire system. Unfortunately, the amount of protactinium observed after the extraction, compared to the amount produced, was extremely small, only 2.5%. The extraction of the protactinium isotope indicated the efficiency of the apparatus was too low to observe the extraction of hahnium. The chemical behavior of oxychloride compounds of bohrium was investigated by isothermal gas adsorption chromatography in a quartz column at 180, 150, and 75 C. It was found to be less volatile than the corresponding compounds of the lighter group seven homologues, rhenium and technetium, which had been measured previously with the same apparatus. Assuming the bohrium compound to be BhO3Cl, the evaluated standard adsorption enthalpy, and delta-Hads, of BhO3Cl on the quartz surface was calculated from Monte Carlo fits to the volatility data to be -75 kJ/mol. The adsorption enthalpies for TcO3Cl and ReO3Cl are -51 and -61 kJ/mol respectively.

NTIS

*Protactinium Isotopes; Alpha Decay*

**20020018022** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Mechanical design of the SNS MEBT**

Oshatz, D.; DeMello, A.; Doolittle, L.; Luft, P.; Staples, J.; Jun. 11, 2001; 3p; In English

Report No.(s): DE2001-785264; LBNL-47343; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Lawrence Berkeley National Laboratory (LBNL) is presently designing and building the 2.5 MeV front end for the Spallation Neutron Source (SNS). The front end includes a medium-energy beam transport (MEBT) that carries the 2.5 MeV, 38 mA peak current, H beam from the radio frequency quadrupole (RFQ) to the drift tube linac (DTL) through a series of 14 electromagnetic quadrupoles, four rebuncher cavities, and a fast traveling wave chopping system. The beamline contains numerous diagnostic devices, including stripline beam position and phase monitors (BPM), toroid beam current monitors (BCM), and beam profile monitors. Components are mounted on three rafts that are separately supported and aligned. The large number of beam transport and diagnostic components in the 3.6 meter-long beamline necessitates an unusually compact mechanical design.

NTIS

*Spallation; Neutron Sources*

**20020018123** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Compact neutron source development at LBNL**

Reijonen, J.; Lou, T. P.; Tolmachoff, B.; Leung, K. N.; Jul. 25, 2001; 8p; In English

Report No.(s): DE2001-785259; LBNL-47265; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A compact neutron generator based on D-D or D-T fusion reactions is being developed at the Lawrence Berkeley National Laboratory. The deuterium or tritium ions are produced in a radio-frequency (RF) driven multicusp plasma source. Seven beamlets are extracted and are accelerated to energy of 100 keV by means of a three-electrode electrostatic accelerator column. The ion beam then impinges on a titanium coated copper target where either the 2.4 MeV D-D or 14 MeV D-T neutrons are generated by fusion reaction. The development of the neutron tube is divided into three phases. First, the accelerator column is operated at hydrogen beam intensity of 15 mA. Second phase consists of deuterium beam runs at pulsed, low duty cycle 150 mA operation. The third phase consists of deuterium or tritium operation at 1.5 A beam current. Phase one is completed and the results of

hydrogen beam testing are discussed. Low duty cycle 150 mA deuterium operation is being investigated. Neutron flux will be measured. Finally the phase three operation and the advance neutron generator designs are described.
NTIS
*Neutron Sources; Particle Accelerators; Electrostatics*

**20020018133** Brookhaven National Lab., Upton, NY USA
**Muon Decay Asymmetries from KOL Yields pi(O) mu(+)m(-) Decays**
Diwan,; Ma,; Trueman,; Jun. 12, 2001; 12p; In English
Report No.(s): DE2001-785046; BNL-68527; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We have examined the decay K(L) to pi(0) mu(+)mu(-) in which the branching ratio, the muon energy asymmetry and the muon decay asymmetry could be measured. In particular, we find that within the Standard Model the longitudinal polarization (PL) of the muon is proportional to the direct CP violating amplitude. On the other hand the energy asymmetry and the out-of-plane polarization (PN) depend on both indirect and direct CP violating amplitudes. Although the branching ratio is small and difficult to measure because of background, the asymmetries could be large O in the Standard Model. A combined analysis of the energy asymmetry, PL and PN could be used to separate indirect CPV, direct CPV, and CP conserving contributions to the decay.
NTIS
*Asymmetry; Muons; Particle Decay*

**20020018159** Stanford Linear Accelerator Center, CA USA
**Measurement of Branching Fractions and Search for CP-violating Charge Asymmetries in Charmless Two-body B Decays into Pions and Kaons**
Dallapiccola, C.; Jul. 25, 2001; 8p; In English
Report No.(s): DE2001-787183; SLAC-PUB-8838; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We present measurements of the branching fractions and a search for CP-violating charge asymmetries in charmless hadronics decays of B mesons into two-body final states of kaons and pions.
NTIS
*Asymmetry; Mesons; Kaons; Pions*

**20020018189** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Neutron tube design study for boron neutron capture therapy application**
Verbeke, J. M.; Lee, Y.; Leung, K. N.; Vujic, J.; Williams, M. D.; May 06, 1999; 3p; In English
Report No.(s): DE2001-785215; LBNL-42463; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Radio-frequency (RF) driven ion sources are being developed in Lawrence Berkeley National Laboratory (LBNL) for sealed-acclerator-tube neutron generator application. by using a 5-cm-diameter RF-driven multicusp source H (+) yields over 95% have been achieved. These experimental findings will enable one to develop compact neutron generators based on the D-D or D-T fusion reactions. In this new neutron generator, the ion source, the accelerator and the target are all housed in a sealed metal container without external pumping. Recent moderator design simulation studies have shown the 14 MeV neutrons could be moderated to therapeutically useful energy ranges for boron neutron capture therapy (BNCT). The does near the center of the brain with optimized moderators is about 65% higher than the dose obtained from a typical neutron spectrum produced by the Brookhaven Medical Research Reactor (BMRR), and is comparable to the dose obtained by other accelerator-based neutron sources. With a 120 keV and 1 A deuteron beam, a treatment time of approx. 85 minutes is estimated for BNCT.
NTIS
*Neutron Sources; Capture Effect; Boron*

**20020018191** Stanford Linear Accelerator Center, Stanford, CA USA
**Top Quark Threshold Production at a gamma-gamma Collider at Next-to-Next-to-Leading Order**
Melnikov, K.; Sep. 14, 2001; 5p; In English
Report No.(s): DE2001-787232; SLAC-PUB-8972; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The next-to-next-to leading order (NNLO) quantum chromodynamics (QCD) corrections to top quark threshold pair production in gamma collisions are computed. The NNLO effects turn out to be significant. Threshold cross sections in gamma and e+e- collisions are compared.
NTIS
*Particle Collisions; Pair Production; Quantum Chromodynamics; Quarks*

**20020018196** Stanford Linear Accelerator Center, Stanford, CA USA

**Measurements of the Cross Section for e+e Yields Hadrons at Center-of-Mass Energies from 2 to 5 GeV**

Dunwoodie, W.; Aug. 29, 2001; 6p; In English

Report No.(s): DE2001-787226; SLAC-PUB-8938; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In precision tests of the Standard Model (SM), the quantities cx(M2z), the quantum electrodynamics (QED) running coupling constant evaluated at the Z pole, and a = (g-2)/2, the anomalous magnetic moment of the muon, are of fundamental importance.

NTIS

*Hadrons; Magnetic Anomalies; Muons; Quantum Electrodynamics*

**20020018199** Stanford Linear Accelerator Center, Stanford, CA USA

**Proceedings of the 2001 e+ e- Physics at Intermediate Energies Workshop**

Jones, R. V.; Sep. 19, 2001; 259p; In English

Report No.(s): DE2001-787222; SLAC-R-573; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We describe a possible experimental apparatus for a proposed new experiment to be carried out at an asymmetrical collider, consisting of the PEP-II Low Energy Ring (LER) and a new electron storage ring (very low Energy Ring, VLER).

NTIS

*Conferences; Storage Rings (Particle Accelerators); Particle Collisions*

**20020018571** Stanford Linear Accelerator Center, Stanford, CA USA

**More on the Interaction Region of PEP-N**

Sullivan, M. K.; Sep. 14, 2001; 5p; In English

Report No.(s): DE2001-787239; SLAC-PUB-8994; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The PEP-N project consists of a small, very low-energy e- storage ring (VLER) located in one of the interaction-straight regions of PEP-IIThe small ring is brought into collision with the low-energy (3.1 GeV) e+ beam (LER).

NTIS

*Particle Collisions; Storage Rings (Particle Accelerators)*

**20020018575** Stanford Linear Accelerator Center, Stanford, CA USA

**Distinguishing Kaluza-Klein Resonances from a Z-prime in Drell-Yan Processes at the LHC**

Rizzo, T. G.; Sep. 20, 2001; 3p; In English

Report No.(s): DE2001-787233; SLAC-PUB-8973; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We explore the capability of the Large Hadron Collider (LHC) to distinguish the production of Kaluza-Klein (KK) excitations in Drell-Yan collisions from an ordinary Z at the LHC in the case of one extra dimension with the fermions localized at the orbifold fixed points. In particular, we demonstrate that this capability is dependent on both the mass of the KK state as well as whether or not the quarks and leptons lie at the same fixed points.

NTIS

*Particle Collisions; Leptons; Excitation*

**20020018577** Stanford Linear Accelerator Center, CA USA

**Evading the CKM Hierarchy**

Brodsky, S. J.; Aug. 15, 2001; 28p; In English

Report No.(s): DE2001-787219; SLAC-PUB-8961; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We show that the presence of intrinsic charm in the hadrons' light-cone wave functions, even at a few percent level, provides new, competitive decay mechanisms for B decays which are nominally CKM-suppressed. For example, the weak decays of the B-meson to two-body exclusive states consisting of strange plus light hadrons, such as B pi K, are expected to be dominated by penguin contributions since the tree-level b suu decay is CKM suppressed. However, higher Fock states in the B wave function containing charm quark pairs can mediate the decay via a CKM-favored b scc tree-level transition. Such intrinsic charm contributions can be phenomenologically significant. Since they mimic the amplitude structure of 'charming' penguin contribution, charming penguins need not be penguins at all.

NTIS

*Hadrons; Wave Functions; Charm (Particle Physics); Light-Cone Expansion*

**20020018838** Stanford Linear Accelerator Center, CA USA
**Charged Current Review**
Robertson, S. H.; Jul. 30, 2001; 9p; In English
Report No.(s): DE2001-787213; SLAC-PUB-8943; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Experimental measurements of the pi lifetime and leptonic branching ratios are combined to give updated world averages for these quantities. The results are then used to test the university of the electroweak charged current couplings to the three lepton species and are found to be consistent with Standard Model predictions at the level of 0.2%, permitting limits to be derived on non-Standard Model physics such as the mass of the pi neutrino.
NTIS
*Leptons; Standard Model (Particle Physics); Charged Particles; Beam Currents*

## 73
## NUCLEAR PHYSICS

*Includes nuclear particles; and reactor theory. For space radiation see 93 Space Radiation. For atomic and molecular physics see 72 Atomic and Molecular Physics. For elementary particle physics see 77 Physics of Elementary Particles and Fields. For nuclear astrophysics see 90 Astrophysics.*

**20020016109** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Commissioning and Operation Experience with the CEBAF Recirculation Arc Beam Transport System**
Chao, Y.; Crofford, M.; Dobeck, N.; Hofler, A.; Hovater, C.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787861; CEBAF-PR-93-048; DOE/ER/40150-1932; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Results of the initial beam tests and early operation of the CEBAF recirculation beam transport system are presented.
NTIS
*Circulation; Linear Accelerators; Beams (Radiation)*

**20020016110** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Compensation of RF-Induced Energy Spread in the CEBAF Injector Chopping System**
Tiefenback, M. G.; Krafft, G. A.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787860; CEBAF-PR-93-047; DOE/ER/40150-1931; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The CEBAF injector chopping system must generate three interleaved 499 MHz pulse trains of independently variable current from a DC input beam prior to axial compression. The chopper consists of two deflection cavities with an aperture midway between them. Lenses flanking the aperture focus the beam from the first cavity into the center of the second, where the RF deflection from the first cavity is removed. The symmetry of the RF energy spread across any time-slice of the beam is dominantly odd. The inverting optics used to focus the beam into the second cavity causes near cancellation of the energy spread from the two cavities. We present experimental measurements of the energy spread effects from a fundamental frequency (1497 MHz) chopper prototype producing a beam of suitable transverse emittance and energy spread, and discuss the expected performance of the subharmonic chopper system to be used for commissioning starting in January 1994.
NTIS
*Linear Accelerators; Energy Distribution; Compensation; Radio Frequencies; Injectors*

**20020016111** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Design and Production of the Higher-Order-Mode Loads for CEBAF**
Campisi, I. E.; Summers, L. K.; Branson, B. H.; Johnson, A. M.; Betto, A.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787859; CEBAF-PR-93-046; DOE/ER/40150-1930; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
At CEBAF, 676 Higher-Order-Mode (HOM) loads are being installed, within the beam vacuum at 2 K, to damp HOM's that affect the stability of the recirculating electron beam. In this paper, the requirements imposed on the loads and the microwave absorbing material comprising them are discussed together with an analysis of their performance and effect on some relevant modes.
NTIS
*Linear Accelerators; Design Analysis; Production; Vacuum; Loads (Forces); Electron Beams*

**20020016112** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Some Operational Characteristics of CEBAF RF Windows at 2K**

Phillips, L.; Reece, C.; Powers, T.; Nguyen-Tuong, V.; May 01, 1993; 3p; In English

Report No.(s): DE2001-787857; CEBAF-PR-93-044; DOE/ER/40150-1928; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A CEBAF superconducting rf cavity was instrumented to examine RF window behavior at 2K. of special interest was window performance at levels of cavity power dissipation considerably above normal operating conditions. A variety of transient electronic activity was observed to occur at or near the rf window, including the emission of light, a precipitous increase in reflected power, and interesting cooperative effects between window and cavity. Typically, the initiation of this activity at the window is correlated with the presence of a high x-ray and energetic electron flux at the window produced by the cavity. Electronic activity at the window can occasionally trigger the sudden disappearance of all stored energy in the cavity, herein referred to as an "electronic quench." Variable decays of up to 40 mu-sec have been observed between the onset of window activity and the decay of the cavity field, which can occur in less than 200 nsec and is always accompanied by an intense pulse of x-rays. When the cavity is off resonance with negligible stored energy, rf fields at the window can be increased even further without the appearance of these effects.

NTIS

*Linear Accelerators; Performance Prediction; Operational Problems*

**20020016137** Fermi National Accelerator Lab., Batavia, IL USA

**Improving the linearity of ferrite loaded cavities using feedback**

Dey, J. E.; Steimel, J.; Jul. 25, 2001; 3p; In English

Report No.(s): DE2001-783404; FERMILAV0CONF-01/167-E; No Copyright; Avail: Department of Energy Information Bridge

A simple beam loading compensation system was installed for the Fermilab Main Injector Coalescing Cavities. This paper describes the design and implementation of the feedback system. These modifications improved the linear dynamic range of operation of the ferrite loaded cavity.

NTIS

*Cavities; Feedback*

**20020016138** Fermi National Accelerator Lab., Batavia, IL USA

**Fermilab Electron Cooling Project: Engineering aspects of cooling section**

Leibfritz, J. R.; Jul. 25, 2001; 3p; In English

Report No.(s): DE2001-783402; FERMILAB-CONF-01/163; No Copyright; Avail: Department of Energy Information Bridge

The Fermilab Electron Cooling project involves interacting a 4.3 MeV, 0.5 A DC electron beam with 8.9 GeV/c antiprotons in the FNAL Recycler Ring. This interaction occurs through a 20-meter long cooling section consisting of 10 solenoid modules. This cooling process would lead to an increase in the Tevatron collider luminosity needed to support RunIIb parameters. There are several important engineering aspects of this cooling section including: solenoid design, vacuum system design, magnetic shielding, support system, and alignment methods. Details of the engineering issues related to each of these areas is discussed.

NTIS

*Electron Beams; Particle Accelerators; Cooling Systems*

**20020016139** Los Alamos National Lab., NM USA

**Developments of 700-mhz 5-cell superconducting cavities for apt**

Tajima, T.; Montoya, D. I.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783283; LA-UR-01-3140; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have manufactured a total of six (beta)=0.64, 700-MHz five-cell cavities. The APT (Accelerator Production of Tritium) specification requires Q(sub 0) greater than 5 x 10(sup 9) at an accelerating field of 5 MV/m. So far, the results of vertical tests have shown maximum accelerating fields of 12 MV/m (peak surface field of 41 MV/m) and maximum low-field Q(sub 0) of 3.6 x 10(sup 10) at 2 K. The present limitations are available input power, field emission and quench. This type of cavities will also be used for an ADTF (Accelerator-Driven Test Facility) for AAA (Advanced Accelerator Applications) project.

NTIS

*Particle Accelerators; Superconducting Cavity Resonators*

**20020016140** Fermi National Accelerator Lab., Batavia, IL USA

**Recent experience with inductive insert at PSR**

Ng, K. Y.; Jul. 24, 2001; 3p; In English

Report No.(s): DE2001-783210; FERMILAB-CONF-01/201-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In a Fermilab-Los Alamos collaboration, inductances constructed of ferrite cores sufficient to cancel a large fraction of the space charge potential-well distortion were installed in the Los Alamos Proton Storage Ring (PSR) as one means of raising the threshold for the two-stream e-p instability. When operating at higher intensities and with sufficient inductance added for full space-charge compensation, an unacceptable longitudinal self-bunching, microwave-like, instability was encountered. Heating the cores to (approximately) 130 C proved to be an effective cure, and was found to be a means for tuning the inductance over a limited but useful range. The heated inductors were an essential ingredient in achieving a record accumulation of 9:7 (micro)C/pulse. An engineered version of the inductors is now installed for routine operation of the PSR. A summary of the inductor characteristics, theory of operation, experimental results, and interpretation will be presented.

NTIS

*Proton Beams; Storage Rings (Particle Accelerators); Inductors; Inductance*

**20020016141** Fermi National Accelerator Lab., Batavia, IL USA

**Fermilab recycler ring**

Hu, M.; Jul. 24, 2001; 3p; In English

Report No.(s): DE2001-783204; FERMILAB-CONF-01/187-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Fermilab Recycler is a permanent magnet storage ring for the accumulation of antiprotons from the Antiproton Source, and the recovery and cooling of the antiprotons remaining at the end of a Tevatron store. It is an integral part of the Fermilab III luminosity upgrade. The following paper describes the design features, operational and commissioning status of the Recycler Ring.

NTIS

*Permanent Magnets; Antiprotons; Storage Rings (Particle Accelerators)*

**20020016143** Fermi National Accelerator Lab., Batavia, IL USA

**Beam loading compensation requirement for multibatch coalescing in Fermilab Main Injector**

Dey, J.; Jul. 24, 2001; 3p; In English

Report No.(s): DE2001-783186; FERMILAB-CONF-01/185-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Fermilab collider Run IIa requires 36 proton bunches with intensities 270E9ppb and 36 antiproton bunches with intensities 40-70E9ppb(1). Currently the proton bunches are produced by coalescing 5-7 53 MHz bunches into one 53 MHz bunch and repeating this process a total of 36 times. It is necessary to coalesce each group of 5-7 bunches (called a 'batch') on independent cycles mainly because of beam loading. The beam loading requirements that would allow us to coalesce four proton batches at a time are presented.

NTIS

*Proton Beams; Particle Collisions; Linear Accelerators*

**20020016178** Brookhaven National Lab., Upton, NY USA

**Neutron Yield Measurements via Aluminum Activation**

Dec. 08, 1999; 19p; In English

Report No.(s): DE2001-762101; No Copyright; Avail: Department of Energy Information Bridge

Neutron activation of aluminum may occur by several neutron capture reactions. Four such reactions are described here: Al-27 + n = Al-28, Al-27(n,(alpha))Na-24, Al-27(n, 2n)Al-26 and Al-27(n,p)Mg-27. The radioactive nuclei Al-28, Na-24, and Mg-27, which are produced via the Al-27 + n = Al-28, Al-27(n,(alpha))Na-24 and Al-27(n,p)Mg-27 neutron reactions, beta decay to excited states of Si-28, Mg-24 and Al-27 respectively. These excited states then emit gamma rays as the nuclei de-excite to their respective ground states.

NTIS

*Aluminum Isotopes; Magnesium Isotopes; Neutron Activation Analysis; Radioactive Decay; Radioactive Isotopes; Beta Particles*

**20020016202** Brookhaven National Lab., Upton, NY USA

**Beam dynamics for a photoinjected energy recovery linac at the NSLS**

Murphy,; Ben-Zvi,; Towne,; Wang,; Wang,; Jun. 18, 2001; 5p; In English

Report No.(s): DE2001-783178; BNL-68384; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Photoinjected Energy Recovery Linac (PERL) design study at the NSLS (National Synchrotron Light Source) is considering the feasibility of a new synchrotron light source based on a 3-7 GeV energy recovering superconducting linac initiated by a photo-injected RF (radio frequency) gun. to be a competitive light source the photoinjector must provide high brightness electron beams with a normalized transverse emittance of 0.5-1 mm-mrad and a bunch charge per of 0.15-0.45 nC at a rep rate of 0.43-1.3 GHz. We provide a first pass assessment of some of the beam dynamics issues that are critical to preserving the high brightness beams.

NTIS

*Synchrotrons; Brightness; Design Analysis; Light Sources; Linear Accelerators; Electron Beams*

**20020016203** Brookhaven National Lab., Upton, NY USA

**Reducing beam coupling impedances in SNS ring extraction kickers**

Kurennoy,; Davino,; Lee,; Jun. 18, 2001; 3p; In English

Report No.(s): DE2001-783177; BNL-68047; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Spallation Neutron Source (SNS) Accumulator ring extraction kickers consists of 14 modules of windowframe ferrite pulsing magnets with the rise time of about 200 ns. Their contribution to the beam coupling impedances is a serious concern. The kicker impedances, as well as its deflecting magnetic field versus time, are studied using detailed 3-D (three dimensional) MAFIA modeling. Various design options, external circuit resistances, and a range of ferrite permeabilities are explored. A kicker module with wide conductor windings around the ferrite behind the kicker current sheet suggests a significant reduction of the kicker transverse and longitudinal coupling impedances. This design provides a good extraction field performance, as demonstrated by electromagnetic simulations. Results of measurements for a small model are also presented.

NTIS

*Design Analysis; Neutron Sources; Three Dimensional Models; Coupling*

**20020016215** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**System for Managing Critical Knowledge for Accelerator Subsystems: Pansophy**

Reece, C.; Bookwalter, V.; Madre, B.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783610; JLAB-ACC-01-11; DOE/ER/40150-1863; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Accelerator development and construction projects often intentionally push the envelope of well-established technical performance and manageable complexity. In addition, the desire for efficient retention and exploitation of accumulated experience across the multi-decade life cycles of major installations calls for a robust, yet user-friendly knowledge management system. To meet these needs, we are presently deploying a new web-based system at Jefferson Lab: Pansophy. This system is a custom integration of several commercial software utilities, DocushareTM, ColdFusionTM, MatlabTM, IngresTM, and common desktop programs. Users of the system range from process managers, shop-floor technicians, test engineers, to after-the-fact data miners and operations staff. The system integrates important QA elements of procedural control, automated data accumulation into a secured central database, prompt and reliable data query and retrieval, and online analysis tools, all accessed by the user via their platform-independent web browser. A system overview, completed pilot project, and implementation experience to date will be presented.

NTIS

*Data Processing; Systems Management; Management Systems; Data Base Management Systems*

**20020016216** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Optimization of Orbit Correction Systems Using Generalized Response Matrices and its Application to the LHC Injection Transfer Lines**

Chao, Y. C.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783608; JLAB-ACC-01-09; DOE/ER/40150-1861; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The LHC injection transfer lines will transport intense high-energy beams over considerable distances. Their relatively tight apertures require precise control of the trajectory. An analytic method has been developed to optimize the performance, reliability and cost of these lines. This method invokes a comprehensive set of performance criteria, makes detailed predictions on orbit

correction effectiveness, configuration defects and critical elements, and gives indications for improvement. A path approaching an optimized configuration can thus be established based on well-defined quantitative criteria.
NTIS
*Beam Injection; Orbits; Trajectories; Apertures*

**20020016248** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Refining and Maintaining the Optimal Performance of the CEBAF SRF Systems**
Reece, C.; Benesch, J.; Preble, J.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783609; JLAB-ACC-01-10; DOE/ER/40150-1862; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

CEBAF at Jefferson Lab is striving to achieve its maximum reliability at the maximum deliverable energy for physics experiments. The most critical part of this is the acceleration systems in the two linacs. The individual limiting characteristics of the 320 srf cavities, each with its own klystron and control system, continue to be refined as is the system for providing optimal setup tools to operations. The field-emission-stimulated discharges at the cold rf waveguide input window continue as the energy-limiting effect. In addition, operation at increased rf power levels have produced unanticipated heating in the region near the warm polymeric rf windows. The latter has stimulated the migration to a more durable ceramic replacement window. During 2000, CEBAF encountered its first cryomodule helium leak into beam vacuum, most likely through an indium wire seal. Characterization of the leak and accommodation methods used will be described.
NTIS
*Radio Frequencies; Superconductors (Materials); Field Emission*

**20020016277** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Construction of the CEBAF RF Separator**
Krycuk, A.; Fugitt, J.; Johnson, A.; Kazimi, R.; Turlington, L.; May 01, 1993; 2p; In English
Report No.(s): DE2001-787856; CEBAF-PR-93-043; DOE/ER/40150-1927; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The CEBAF accelerator is designed in a multipass racetrack configuration, with two 1497 MHz linear accelerator sections joined by independent magnetic transport arcs. Room temperature subharmonic rf separator cavities will be used on each independent arc to extract a portion of the recirculating beam, and one additional cavity will be used to divide the final full-energy beam between CEBAF's three experimental end stations. A single-cell prototype cavity has already been built and tested a low power levels. The next stage of the design process is the construction of a cavity capable of operation at full power, i.e. at a gradient sufficient to provide the required mu-rad bend to a 6 GeV beam. The paper will discuss both the electrical and mechanical design of the cavity, construction techniques employed, and preliminary test results.
NTIS
*Separators; Fabrication; Linear Accelerators; Radio Frequencies; Beam Splitters*

**20020016278** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Commissioning of the CEBAF Cryomodules**
Drury, M.; Lee, T.; Marshall, J.; Preble, J.; Saulter, Q.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787855; CEBAF-PR-93-042; DOE/ER/40150-1926; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

When complete, the Continuous Electron Beam Accelerator Facility will house a 4 GeV recirculating linear accelerator containing 42 1/4 cryomodules arrayed in two antiparallel linacs and an injector. Currently, over half of the cryomodules have been installed. Each cryomodule contains eight superconducting niobium 5-cell rf cavities that operate at 1.497 GHz. A cryomodule must provide an energy gain of 20 MeV to the 200 mu-A beam. The resultant dynamic heat load must be less than 45 W.
NTIS
*Linear Accelerators; Research Facilities; Dynamic Loads; Electron Beams*

**20020016279** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Operation of the CEBAF Linac with High Beam Loading**
Merminga, L.; Bisognano, J. J.; Hovater, C.; Krafft, G. A.; Simrock, S. N.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787854; CEBAF-PR-93-041; DOE/ER/40150-1925; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The superconducting RF, CW CEBAF accelerator will use a pair of antiparallel 400 MeV linacs connected by recirculation arcs for nominal 4 GeV in five passes. Single-pass, high power testing of the first linac has been conducted during the months preceding the conference. The RF control system has been designed to control cavity gradient and phase under a wide range of gradients and significant beam loading. At full beam current, accelerating gradient is approximately equal to accelerating voltage in the superconducting RF cavities. Even though the beam current during the high power testing is one-fifth of the full current, beam loading is substantial. Operational experience of the response of the RF system is presented. A tuning algorithm which compensates for beam loading effects has been developed and tested. Heavy beam loading, corresponding to five-pass operation, was studied by increasing the loaded <i>Q</i> of the cavities. A current modulation experiment addressed the issue of energy spread increase due to current fluctuations, and the effect of by-passed cavities on beam properties was investigated.
NTIS
*Beam Currents; Linear Accelerators; Beams (Radiation); Superconductivity*

**20020016280** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Orbit Correction Implementation at CEBAF**
Bickley, M.; Bowling, B. A.; Douglas, D.; Hofler, A.; Kewisch, J.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787853; CEBAF-PR-93-040; DOE/ER/40150-1924; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

CEBAF has recently performed automated beam orbit control in real time. This effort was achieved by exploiting the capabilities of the TACL control system, using the newly implemented STAR network, which easily yielded the required data transfer density needed. Also involved in this effort was the On-Line Envelope code OLE, which provided first-order transfer matrices that reflected the current machine optics. These tools made the implementation of the specific orbit-correction algorithms easier and increased reliability. The implemented algorithms include beam-threading, orbit-locks with 2 correctors/2 monitors, most-effective corrector, and eta-corrector/eta-monitor correction.
NTIS
*Automatic Control; Orbit Spectrum Utilization; Linear Accelerators*

**20020016364** Los Alamos National Lab., NM USA
**Evaluation and Testing of a Low-B Spoke Resonator**
Tajima, T.; Montoya, D. I.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783284; LA-UR-01-3141; No Copyright; Avail: Department of Energy Information Bridge

Within the framework of the Advanced Accelerator Applications (AAA) project we are interested in building and testing low-beta spoke resonators (cavities). to familiarize us with the specifics of these structures Argonne National Laboratory (ANL) kindly loaned us one of their spoke cavities for evaluation. This is a beta = 0.291 two-gap resonator at 340 MHz. We benchmarked our computer codes by comparing room temperature measurements of frequency, tuning sensitivity, tuning forces, etc., with our 3D simulation results. The cavity was tested at both 4 K and 2 K. The results showed maximum accelerating gradients of 12.5 MV/m (4 K) and 12.3 MV/m (2 K), which correspond to a peak electric field of 40 MV/m and a peak magnetic field of 1063 Ohms. Q(sub 0) values at 5 MV/m also exceeded by more than a factor two of present AAA specification. These results encouraged us toward development of spoke cavities for the low energy section (6.7 MeV to 109 MeV) of ADTF (Accelerator-Driven Test Facility) of AAA project.
NTIS
*Tuning; Cavity Resonators; Performance Tests*

**20020016377** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Thermal analysis model for high power density beam stops**
Virostek, S.; Oshatz, D.; Staples, J.; Jun. 08, 2001; 3p; In English
Report No.(s): DE2001-783487; LBNL-47341; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Lawrence Berkeley National Laboratory (LBNL) is presently designing and building the 2.5 MeV injector for the Spallation Neutron Source (SNS). The design includes various beam intercepting devices such as beam stops and slits. The target power densities can be as high as 500 kW/cm(sup 2) with a beam stopping range of 25 to 30 microns, producing stresses well above yield in most materials. In order to analyze the induced temperatures and stresses, a finite element model has been developed. The model has been written parametrically to allow the beam characteristics, target material, dimensions, angle of incidence and mesh densities to be easily adjusted. The heat load is applied to the model through the use of a 3-dimensional table containing the

calculated volumetric heat rates. The load is based on a bi-gaussian beam shape which is absorbed by the target according to a Bragg peak distribution. The results of several analyses using the SNS Front End beam are presented.
NTIS
*Thermal Analysis; Beam Injection; Finite Element Method; Mathematical Models; Beams (Radiation); Density (Number/Volume)*

**20020016396** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Energy Vernier System for CEBAF**
Krafft, G. A.; Bisognano, J. J.; Crofford, M. T.; Hovater, C.; Merminga, L.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787850; CEBAF-PR-93-037; DOE/ER/40150-1921; No Copyright; Avail: Department of Energy Information Bridge

The beam energy of CEBAF must be accurately controlled for precise physics experiments. In order to achieve a relative energy spread better than sigma'' = 2.5 x 5, a feedback system is needed to stabilize the energy against phase and amplitude fluctuations in the individual cavities. In the energy vernier system, the energy deviation of the beam is measured at a location with high dispersion. The error signal controls the accelerating gradient of selected vernier cavities. The methods used to correct the energy will be discussed, as well as the noise sources in the system. The results of beam tests at the CEBAF north linac will also be reported.
NTIS
*Particle Accelerators; Beams (Radiation); Vernier Engines*

**20020016399** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**CEBAF Analog Monitoring System**
Crawford, K.; Perry, J.; Simrock, S.; May 01, 1993; 3p; In English
Report No.(s): DE2001-787852; CEBAF-PR-93-039; DOE/ER/40150-1923; No Copyright; Avail: Department of Energy Information Bridge

The purpose of the analog monitoring system (AMS) is to provide CEBAF operators the ability to monitor voltage signals from the RF control modules, beam loss monitors, and other dedicated systems from the accelerator services buildings with a 10 MHz (-1 dB), bandwidth. The signals are presented at the AMS receiving crate in the Machine Control Center (MCC). The system, when completed, will allow the operator to monitor any 4 signals from available channels in each location. At present, these locations provide 800 signals in each of the linacs, 16 signals in each of the arcs, 120 signals in the injector, and 16 signals in the beam switch-yard. This provides a total capacity of 1768 signals, with an upgrade ability of 3740 total signal capacity.
NTIS
*Linear Accelerators; Analog Data; Monitors; Electric Potential*

**20020016403** Fermi National Accelerator Lab., Batavia, IL USA
**Comparative study of medium damped and detuned linear accelerator structures**
Ostiguy, J. F.; Aug. 22, 2001; 3p; In English
Report No.(s): DE2001-784604; FERMILAB-CONF-01/183; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Long range wakefields are a serious concern for a future linear collider based on room temperature accelerating structures. They can be suppressed either by detuning and or local damping or with some combination of both strategies. Detuning relies on precisely phasing the contributions of the dipole modes excited by the passage of a single bunch. This is accomplished by controlling individual mode frequencies, a process which dictates individual cell dimensional tolerances. Each mode must be excited with the correct strength; this in turn, determines cell-to-cell alignment tolerances. In contrast, in a locally damped structure, the modes are attenuated at the cell level. Clearly, mode frequencies and relative excitation become less critical in that context; mechanical fabrication tolerances can be relaxed. While local damping is ideal from the stand-point of long range wakefield suppression, this comes at the cost of reducing the shunt impedance and possibly unacceptable localized heating. Recently, the Medium Damped Structure (MDS), a compromise between detuning and local damping, has generated some interest. In this paper, we compare a hypothetical MDS to the NLC Rounded Damped Detuned Structure (RDDS) and investigate possible advantages from the standpoint fabrication tolerances and their relation to beam stability and emittance preservation.
NTIS
*Linear Accelerators; Damping; Heating; Alignment; Impedance*

**20020016404** Fermi National Accelerator Lab., Batavia, IL USA

**62-TeV center of mass hadron collider with capability for super bunch beams**

Takayama, K.; Yamada, R.; Aug. 22, 2001; 3p; In English

Report No.(s): DE2001-784603; FERMILAB-CONF-01/147-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A 60 TeV center of mass hadron collider is proposed, which has capability of using Superbunch beam. With Superbunch beam, the luminosity is expected to be increased by a factor of 20, compared with conventional acceleration using RF cavities. This hadron collider will be built in two stages with a low field magnet ring first and a high field magnet ring later in the same tunnel. The low field magnet rig will be built with Pipetron scheme, with 7 TeV and 7 TeV proton beams, making a 14 TeV center of mass energy high luminosity collider, using Superbunch beams. In the second stage 10 Tesla high field magnets with twin beams, will be installed. It also utilizes Superbunch beams, realizing high luminosity collider. to accelerate Superbunch beams, the barrier bucket and acceleration induction cells will be used, which are made of induction cells, utilizing FINEMET material. The core loss of the FINEMET is estimated for the whole collider is estimated. The synchrotron radiation of the collider is also estimated. Merits of Superbunch beams over RF bunched beams for the high energy experiments is described.

NTIS

*Bunching; Synchrotron Radiation; Radio Frequencies*

**20020016405** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Neutrino factory and muon collider collaboration R and D activities**

Zisman, M. S.; Mar. 22, 2001; 5p; In English

Report No.(s): DE2001-783881; LBNL-48238; No Copyright; Avail: Department of Energy Information Bridge

The Neutrino Factory and Muon Collider Collaboration (MC) comprises about 140 U.S. and non-U.S. accelerator and particle physicists. The MC is carrying out an R and D program aimed at validating the critical design concepts required for the construction of such machines. We are committed to encouraging international cooperation and coordination of the R and D effort. Main activities of the MC include a Targetry program, a MUCOOL program, a component development program, and a theory and simulation effort. Moreover, the MC has participated in several feasibility studies for a complete Neutrino Factory facility, with the aim of identifying any additional R and D activities needed to prepare a Zeroth-order Design Report (ZDR) in about two years and a Conceptual Design report (CDR) about two years thereafter. In this paper, the R and D goals in each area will be indicated, and the present status and future plans of the R and D program will be described.

NTIS

*Muons; Neutrinos; Research and Development*

**20020016406** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Technical implementation of feasibility study-II design**

Zisman, M. S.; Ozaki, S.; Palmer, R. B.; Mar. 22, 2001; 3p; In English

Report No.(s): DE2001-783880; LBNL-48231; No Copyright; Avail: Department of Energy Information Bridge

An updated Feasibility Study for a high-performance Neutrino Factory has been undertaken by Brookhaven National Laboratory (BNL) and the Neutrino Factory and Muon Collider Collaboration (MC). We describe the technical implementation of the facility. Details of the key components are shown, and R and D activities that need to be addressed to proceed toward a facility design are indicated.

NTIS

*Neutrinos; Feasibility Analysis; Industrial Plants*

**20020016407** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Impedance and instabilities in the NLC damping rings**

Corlett,; Li,; Pivi,; Rimmer,; DeSantis, S.; Jun. 12, 2001; 3p; In English

Report No.(s): DE2001-783879; LBNL-48200; No Copyright; Avail: Department of Energy Information Bridge

We report on impedance calculations and single-bunch and multi-bunch instabilities in the NLC damping rings. Preliminary designs of vacuum chambers and major components have addressed beam impedance issues, with the desire to increase instability current thresholds and reducing growth rates. MAFIA calculations of short-range and long-range wakefields have allowed computations of growth rates and thresholds, which are presented here. Resistive wall instability dominates long-range effects,

and requires a broadband feedback system to control coupled-bunch motion. Growth rates are within the range addressable by current feedback system technologies. Single-bunch instability thresholds are safely above nominal operating current.
NTIS
*Impedance; Stability; Damping*

**20020016408** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Next linear collider damping ring complex**
Corlett,; Atkinson,; DeSantis,; Hartman,; Kennedy,; Jun. 12, 2001; 3p; In English
Report No.(s): DE2001-783878; LBNL-48199; No Copyright; Avail: Department of Energy Information Bridge

We report progress on the design of the Next Linear Collider (NLC) Damping Rings complexes. The purpose of the damping rings is to provide low emittance electron and positron bunch trains to the NLC linacs, at a rate of 120 Hz. As an option to operate at the higher rate of 180 Hz, two 1.98 GeV main damping rings per beam are proposed, and one positron pre-damping ring. The main damping rings store up to 0.8 amp in 3 trains of 190 bunches each and have normalized extracted beam emittances (gamma)(var epsilon)x = 3 mm-mrad and (gamma)(var epsilon)y = 0.02 mm-mrad. The optical designs, based on a theoretical minimum emittance lattice (TME), are described, with an analysis of dynamic aperture and non-linear effects. Key subsystems and components are described, including the wiggler, the vacuum systems and photon stop design, and the higher-order-mode damped RF cavities. Impedance and instabilities are discussed.
NTIS
*Particle Collisions; Damping; Linear Accelerators*

**20020016423** Brookhaven National Lab., Upton, NY USA
**Injection choice for spallation neutron source ring**
Wei,; Beebe-Wang,; Blaskiewicz,; Brodowski,; Fedotov,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783734; BNL-68055; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Injection is key in the low-loss design of high-intensity proton facilities like the Spallation Neutron Source (SNS). During the design of both the accumulator and the rapid-cycling-synchrotron version of the SNS, extensive comparison has been made to select injection scenarios that satisfy SNS's low-loss design criteria. This paper presents issues and considerations pertaining to the final choice of the SNS injection systems.
NTIS
*Neutron Sources; Beam Injection; Accumulators; Design Analysis*

**20020016424** Brookhaven National Lab., Upton, NY USA
**Design optimization and the path towards a 2 mw spallation neutron source**
Wei,; Blaskiewicz,; Catalan-Lasheras,; Davino,; Fedotov,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783733; BNL-68054; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Spallation Neutron Source (SNS) is designed to ultimately reach an average proton beam power of 2 MW for pulsed neutron production. The SNS physics groups analyze the machine performance within the hardware constraints, optimize the accelerator design, and establish the best path towards a 2 MW and higher spallation neutron source.
NTIS
*Neutron Sources; Design Optimization*

**20020016439** Argonne National Lab., IL USA
**Physics goals for the planned next linear collider engineering test facility**
Bohn, C.; Michelotti, L.; Ostiguy, J. F.; Syphers, M.; Bluem, H.; Jul. 17, 2001; 3p; In English
Report No.(s): DE2001-783659; ANL-HEP-CP-01-65; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Next Linear Collider (NLC) Collaboration is planning to construct an Engineering Test Facility (ETF) at Fermilab. As presently envisioned, the ETF would comprise a fundamental unit of the NLC main linac to include X-band klystrons and modulators, a delay-line power-distribution system (DLDS), and NLC accelerating structures that serve as loads. The principal purpose of the ETF is to validate stable operation of the power-distribution system, first without beam, then with a beam having the NLC pulse structure. This paper concerns the possibility of configuring and using the ETF to accelerate beam with an NLC

pulse structure, as well as of doing experiments to measure beam-induced wakefields in the rf structures and their influence back on the beam.
NTIS
*Linear Accelerators; Test Facilities*

**20020016454** Los Alamos National Lab., NM USA
**New Temperature and X-Ray Mapping System for 700-MHz 5-Cell Superconducting Cavities**
Tajima, T.; Gentzlinger, R. C.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783286; LA-UR-01-3163; No Copyright; Avail: Department of Energy Information Bridge

A new system to map temperature and X-ray radiation around the external surface of 700-MHz five-cell superconducting cavities has been developed. It consists of an aluminum cylinder that is equipped with six modules of sensors. Eighty-one carbon resistors (temperature sensors) and 71 PIN diodes (X-ray sensors) are attached. This cylinder surrounds the five-cell cavity and rotates about the cavity axis in about six minutes. A new feature, compared to the ones developed in the past, is its brush-contact mechanism on the outer surface of the aluminum cylinder, which enables the sensor array to rotate continuously in the same direction during the test. Although the present mechanism allows only one direction of rotation, it does not seem to be difficult to modify for both directions if electrical connections work in this manner. This paper describes the details of the structure and associated mechanisms as well as future schedule and plans of operation.
NTIS
*Cavity Resonators; Superconductivity; X Rays; Design Analysis*

**20020016676** Fermi National Accelerator Lab., Batavia, IL USA
**CDF data acquisition system for Tevatron Run II**
Meyer, A.; Aug. 27, 2001; 4p; In English
Report No.(s): DE2001-785039; FERMILAB-CONF-01/242-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

With minor exceptions, all electronics systems had to be replaced to accommodate the larger instantaneous luminosity in the Tevatron Run II, with a similar increase in data transfer rates, and more importantly, to allow for a bunch separation of as low as 132 ns. The Level 1 trigger system is synchronized with the 132 ns clock, and forms a decision without incurring dead time at the end of a 42-crossing deep pipeline (5:5 s). Upon receiving a Level 1 trigger, the data on each front-end board are transferred to one of four Level 2 burners. The Level 2 trigger operates asynchronously and has an average decision time of 20 s. Upon a positive Level 2 decision, the event is read out into DAQ burners and then transferred via a network switch to the Level 3 farm, where the complete event is assembled, analyzed, and, if accepted, sent to the data logger.
NTIS
*Particle Accelerators; Actuators; Luminosity*

**20020016677** Fermi National Accelerator Lab., Batavia, IL USA
**Status of flat electron beam production**
Edwards, D. A.; Aug. 24, 2001; 3p; In English
Report No.(s): DE2001-785004; FERMILAB-CONF-01/218-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Last year at LINA2000 we reported our initial verification of the round beam (comparable transverse emittances) to flat beam (high transverse emittance ratio) transformation described by Brinkman Derbenev, and Flottmann. Further analysis of our data has confirmed that a transverse emittance ratio of approximately 50 was observed. Graphics representing observational detail are included here, and future plans outlined.
NTIS
*Electron Beams; Beamforming*

**20020016680** Fermi National Accelerator Lab., Batavia, IL USA
**Space charge and beam stability issues of the Fermilab proton driver in Phase I**
Ng, K. Y.; Aug. 24, 2001; 25p; In English
Report No.(s): DE2001-784993; FERMILAB-TM-2154; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Issues concerning beam stability of the proposed Fermilab Proton Driver are studied in its Phase I. Although the betatron tune shifts are dominated by space charge, these shifts are less than 0.25 and will therefore not drive the symmetric and antisymmetric

modes of the beam envelope into instability. The longitudinal space charge force is large and inductive inserts may be needed to compensate for the distortion of the rf potential. Although the longitudinal impedance is space charge dominated, it will not drive any microwave instability, unless the real part of the impedance coming from the inductive inserts and wall resistivity of the beam tube are large enough. The design of the beam tube is therefore very important in order to limit the flow of eddy current and keep wall resistivity low. The transverse impedance is also space charge dominated.
NTIS
*Space Charge; Radio Frequencies; Stability*

**20020016690** Fermi National Accelerator Lab., Batavia, IL USA
**Program in muon and neutrino physics: Superbeams, cold muon beams, neutrino factory and the Muon Collider**
Raja, R.; Aug. 08, 2001; 131p; In English
Report No.(s): DE2001-784174; FERMILAB-CONF-01/226-E; No Copyright; Avail: Department of Energy Information Bridge
The concept of a Muon Collider was first proposed by Budker and by Skrinsky in the 60s and early 70s. However, there was little substance to the concept until the idea of ionization cooling was developed by Skrinsky and Parkhomchuk. The ionization cooling approach was expanded by Neufer and then by Palmer, whose work led to the formation of the Neutrino Factory and Muon Collider Collaboration (MC) in 1995. The concept of a neutrino source based on a pion storage ring was originally considered by Koshkarev. However, the intensity of the muons created within the ring from pion decay was too low to provide a useful neutrino source. The Muon Collider concept provided a way to produce a very intense muon source. The physics potential of neutrino beams produced by muon storage rings was investigated by Geer in 1997 at a Fermilab workshop where it became evident that the neutrino beams produced by muon storage rings needed for the muon collider were exciting on their own merit. The neutrino factory concept quickly captured the imagination of the particle physics community, driven in large part by the exciting atmospheric neutrino deficit results from the SuperKamiokande experiment. As a result, the MC realized that a Neutrino Factory could be an important first step toward a Muon Collider and the physics that could be addressed by a Neutrino Factory was interesting in its own right. With this in mind, the MC has shifted its primary emphasis toward the issues relevant to a Neutrino Factory. There is also considerable international activity on Neutrino Factories, with international conferences held at Lyon in 1999, Monterey in 2000, Tsukuba in 2001, and another planned for London in 2002.
NTIS
*Muons; Neutrino Beams*

**20020016693** Brookhaven National Lab., Upton, NY USA
**Beam dynamics simulations for a dc gun based injector for perl**
Zhou,; BenZvi,; Wang,; Jun. 18, 2001; 5p
Report No.(s): DE2001-783990; BNL-68467; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory (BNL) is considering an upgrade based on the Photoinjected Energy Recovering Linac (PERL). The various injector schemes for this machine are being extensively investigated at BNL. One of the possible options is photocathode DC gun. The schematic layout of a PERL DC gun based injector and its preliminary beam dynamics are presented in this paper. The transverse and longitudinal emittance of photo-electron beam were optimized for a DC field 500 kV.
NTIS
*Electron Guns; Beam Injection*

**20020016696** Brookhaven National Lab., Upton, NY USA
**Impact of magnetic field interference in the sns ring**
Papaphilippou,; Lee,; Meng,; Jun. 18, 2001; 3p; In English
Report No.(s): DE2001-783987; BNL-68050; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The modest size of the SNS accumulator ring and the use of short, large aperture magnets makes unavoidable the overlapping between the magnetic end fields of the quadrupoles with the adjacent multipole correctors. This interference effect can be quantified through magnetic field simulations and measurements. The impact to the beam dynamics is finally discussed.
NTIS
*Magnetic Fields; Storage Rings (Particle Accelerators)*

**20020016706** California Univ., Berkeley, CA USA
**Updated electron-cloud simulation results for the Large Hadron Collider (LHC)**
Furman, M. A.; Pivi, M.; Jun. 26, 2001; 3p; In English
Report No.(s): DE2001-783884; LBNL-48380; CBP-NOTE-396; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper presents new simulation results for the power deposition from the electron cloud in the beam screen of the Large Hadron Collider (LHC). We pay particular attention to the sensitivity of the results to certain low-energy parameters of the secondary electron (SE) emission. Most of these parameters, which constitute an input to the simulation program, are extracted from recent measurements at CERN and SLAC.
NTIS
*Hadrons; Particle Collisions; Secondary Emission; Electron Clouds*

**20020016719** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Beam tube vacuum in a Very Large Hadron Collider; Stage 1 VLHC**
Pivi, M.; Turner, W. C.; Apr. 20, 2001; 6p; In English
Report No.(s): DE2001-785292; LBNL-47810; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Synchrotron radiation induced photodesorption in particle accelerators may lead to pressure rise and to beam-gas scattering losses, finally affecting the beam lifetime. We discuss the beam tube vacuum in the low field Stage 1 Very Large Hadron Collider VLHC. Since VLHC Stage 1 has a room temperature beam tube, a non-evaporable getter (NEG St101 strip) pumping system located inside a pumping antechamber, supplemented by lumped ion pumps for pumping methane is considered. A possible beam conditioning scenario is presented for reaching design intensity. The most important results are summarized in this paper. More detailed reports of the calculations will be presented at the PAC2001 Conference, Chicago, IL to be held in June 2001, and at the Snowmass Conference, CO, to be held on July 2001.
NTIS
*Superconducting Super Collider; Particle Accelerators; Hadrons; Beamforming*

**20020016866** Stanford Linear Accelerator Center, CA USA
**Next Linear Collider Design: NLC 2001**
Larsen, A.; Aug. 21, 2001; 162p; In English
Report No.(s): DE2001-787172; SLAC-R-571; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There have been many advances in elementary particle physics since the U.S. High Energy Physics (HEP) community last met at Snowmass, CO in 1996. New results have made the need for a linear collider able to reach TeV energies with high luminosity more compelling than ever. International research and development for such a linear collider has kept pace, and the technology for such a collider now exists. Work in the USA on the Next Linear Collider (NLC), and the writing of this Report, is led by the Stanford Linear Accelerator Center (SLAC), Fermi National Accelerator Laboratory (FNAL), Lawrence Berkeley National Laboratory (LBNL), and Lawrence Livermore National Laboratory (LLNL). Teams from Bechtel Nevada, the University of California at Davis, Los Alamos National Laboratory, the University of Massachusetts, and Stanford University have also made major contributions to the results in this Report.
NTIS
*Particle Collisions; Linear Accelerators*

**20020016901** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Performance Report of the US Department of Energy's Thomas Jefferson National Accelerator Facility**
Murphy, J.; Jun. 01, 2001; 24p; In English
Report No.(s): DE2001-784300; JLAB-DO-01-01; DOE/ER/40150-1894; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Jefferson Lab (JLab), the newest of the US Department of Energy's (DOE's) 16 national laboratories, has been functioning effectively since its inception in 1984, first during construction and now during operations. As shown in this report, JLab aligns itself directly with DOE's strategic planning, both in terms of laboratory visions and plans and in terms of actual laboratory performance. Most importantly, JLab contributes significantly to DOE's Science and Technology mission in the area of nuclear physics, under the Office of Science. The laboratory practices continuous improvement and has made a number of important effectiveness and efficiency enhancements in recent years. Laboratory performance has been demonstrated by completion of the construction phase on cost and schedule, by exceeding technical specifications when coming on-line for physics research, and

now during operations by earning ratings of 'outstanding' relative to the performance measures in the laboratory's performance-based contract with DOE.
NTIS
*Laboratories; Research and Development; Particle Accelerators*

**20020016905** Brookhaven National Lab., Upton, NY USA
**Linear Collider Physics Resource Book for Snowmass 2001**
Abe,; Dawson,; Heinemeyer,; Marciano,; Paige,; May 03, 2001; 440p; In English
Report No.(s): DE2001-784250; BNL-52627; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The American particle physics community can look forward to a well-conceived and vital program of experimentation for the next ten years, using both colliders and fixed target beams to study a wide variety of pressing questions. Beyond 2010, these programs will be reaching the end of their expected lives. The CERN Large Hadron Collider (LHC) will provide an experimental program of the first importance. But beyond the LHC, the American community needs a coherent plan. The Snowmass 2001 Workshop and the deliberations of the HEPAP subpanel offer a rare opportunity to engage the full community in planning our future for the next decade or more. A major accelerator project requires a decade from the beginning of an engineering design to the receipt of the first data. So it is now time to decide whether to begin a new accelerator project that will operate in the years soon after 2010. We believe that the world high-energy physics community needs such a project. With the great promise of discovery in physics at the next energy scale, and with the opportunity for the uncovering of profound insights, we cannot allow our field to contract to a single experimental program at a single laboratory in the world. We believe that an e(+)e(-) linear collider is an excellent choice for the next major project in high-energy physics. Applying experimental techniques very different from those used at hadron colliders, an e(+)e(-) linear collider will allow us to build on the discoveries made at the Tevatron and the LHC, and to add a level of precision and clarity that will be necessary to understand the physics of the next energy scale. It is not necessary to anticipate specific results from the hadron collider programs to argue for constructing an e(+)e(-) linear collider; in any scenario that is now discussed, physics will benefit from the new information that e(+)e(-) experiments can provide.
NTIS
*Particle Accelerators; Project Planning*

**20020017269** Fermi National Accelerator Lab., Batavia, IL USA
**BTeV DAQ and Trigger System: Some throughput, usability and fault tolerance aspects**
Gottschalk, E. E.; Aug. 20, 2001; 4p; In English
Report No.(s): DE2001-784508; FERMILAB-CONF-01/227-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As presented at the last CHEP conference, the BTeV triggering and data collection pose a significant challenge in construction and operation, generating 1.5 Terabytes/second of raw data from over 30 million detector channels. We report on facets of the DAQ and trigger farms. We report on the current design of the DAQ, especially its partitioning features to support commissioning of the detector. We are exploring collaborations with computer science groups experienced in fault tolerant and dynamic real-time and embedded systems to develop a system to provide the extreme flexibility and high availability required of the heterogeneous trigger farm (approximately ten thousand DSPs and commodity processors). We describe directions in the following areas: system modeling and analysis using the Model Integrated Computing approach to assist in the creation of domain-specific modeling, analysis, and program synthesis environments for building complex, large-scale computer-based systems; System Configuration Management to include compilable design specifications for configurable hardware components, schedules, and communication maps; Runtime Environment and Hierarchical Fault Detection/Management - a system-wide infrastructure for rapidly detecting, isolating, filtering, and reporting faults which will be encapsulated in intelligent active entities (agents) to run on DSPs, L2/3 processors, and other supporting processors throughout the system.
NTIS
*Particle Accelerators; Data Acquisition; Fault Tolerance; Radiation Detectors*

**20020017270** Fermi National Accelerator Lab., Batavia, IL USA
**Design and implementation of the medium-beta insert of the Fermilab recycler ring**
Wan, W.; Aug. 15, 2001; 3p; In English
Report No.(s): DE2001-784406; FERMILAB-CONF-01/210; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The design of the newly installed medium-(beta) insert of the Fermilab Recycler Ring is presented. The design philosophy is outlined. The stringent optical and physical constraints, as well as their influence on the design, are discussed. The impact of the medium-(beta) insert on the Recycler Ring is shown. Engineering design and installation of the new insert is presented.
NTIS
*Storage Rings (Particle Accelerators); Inserts*

**20020017403** NATO Advanced Study Inst., Brussels Belgium
**NATO ASI at Windsor on 13-26 August Programme**
Aug. 26, 2001; 25p; In English
Contract(s)/Grant(s): N68171-01-M-5920
Report No.(s): AD-A396905; R/D-9099-PH-02; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Presents a number of abstracts from a conference held on elementary particles, electronics and other related areas in physics. Topics covered include: 1) Integrable models for confined fermions, 2) Quantum and classical localization in two-dimensional network models, 3) Quantum Hall Effect, and 4) Superconductor-Ferromagnet-Superconductor Junctions.
CASI
*Quantum Theory; Bosons; Elementary Particles; Nanostructure (Characteristics); Quantum Electronics; Electrophysics*

**20020017415** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**Computational Modeling of a Time-Independent, Heterogeneous Reactor Core Using Simplified Discrete Ordinates Neutron Transport Techniques**
Labowski, Kristofer S.; Sep. 2001; 157p; In English
Report No.(s): AD-A396827; AFIT/GAP/ENP/01S-01; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
The Linear Characteristic (LC) method on rectangular boxoid meshes is a discrete ordinate neutron transport technique that uses both zeroth and first moments of the angular neutron flux to construct a relatively accurate representation of neutron particle distributions in a given medium. The significant number of calculations required by LC when compared to more conventional methods such as Diamond Difference vastly increases computational time by a factor of 60 (or minutes to hours). A modified extrapolation, linear acceleration method with iterative shooting capability was adapted along with approximated initial guesses to the scalar flux to effectively reduce LC computational times by as much as 70% to 90%. Unlike conventional methods that contain instabilities and errors that are accentuated and magnified at optically thick boundaries, the LC method calculated stable consistent flux results through boundary regions of varying absorptive materials. The inherently computationally intensive linear algebra used by the LC method was simplified using FORTRAN 90/95 programming commands designed to optimize vector and matrix calculations and reduce and simplify the overall source code.
DTIC
*Algebra; Method of Characteristics; Neutrons; Boundaries; Extrapolation; Neutron Distribution*

**20020017530** Princeton Univ., Plasma Physics Lab., NJ USA
**Noninductive Current Generation in NSTX using Coaxial Helicity Injection**
Raman, R.; Jarboe, T. R.; Mueller, D.; Schaffer, M. J.; Maqueda, R.; May 10, 2001; 23p; In English
Report No.(s): DE2001-784548; PPPL-3562; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Coaxial Helicity Injection (CHI) on the National Spherical Torus Experiment (NSTX) has produced 240 kA of toroidal current without the use of the central solenoid. Values of the current multiplication ratio (CHI produced toroidal current/injector current) up to 10 were obtained, in agreement with predictions. The discharges which lasted for up to 200 ms, limited only by the programmed waveform, are more than an order of magnitude longer in duration that any CHI discharges previously produced in a Spheromak or a Spherical Torus (ST).
NTIS
*Toruses; Beam Injection*

**20020017531** Princeton Univ., Plasma Physics Lab., NJ USA
**Initial Results from Coaxial Helicity Injection Experiments in NSTX**
Raman, R.; Jarboe, T. R.; Mueller, D.; Schaffer, M. J.; Maqueda, R.; May 10, 2001; 24p; In English
Report No.(s): DE2001-784547; PPPL-3561; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Coaxial Helicity Injection (CHI) has been investigated on the National Spherical Torus Experiment (NSTX). Initial experiments produced 130 kA of toroidal current without the use of the central solenoid. The corresponding injector current was 20 kA. Discharges with pulse lengths up to 130 ms have been produced.
NTIS
*Beam Injection; Toruses*

**20020017535** Fermi National Accelerator Lab., Batavia, IL USA
**Tevatron optics with magnet moves for Roman pots at CDF**
Johnstone, J. A.; Aug. 16, 2001; 13p; In English
Report No.(s): DE2001-784419; FERMILAB-TM-2157; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

CDF would like to install high precision track detectors. There is ample room on A-sector side, but space needs to be created at B11. The favored plan is to show the first 3 B11 dipoles inwards toward the IP by 2.274 m. This would require removal of the inert Q1 quadrupole and its spool plus an extensive number of other mechanical and cryogenic modifications. The orbit distortion these modifications introduce would then be compensated by shifting the six B16 and B17 dipoles outwards by about half that amount. Space for this dipole move could be generated by replacing the 72 inch spool at B18 with a short 43 inch spool, and removing the 16.5 inch spacer after B17-5.
NTIS
*Particle Accelerators; Optical Materials*

**20020017537** Fermi National Accelerator Lab., Batavia, IL USA
**Space-charge compensation in proton boosters**
Shiltsev, V.; Aug. 15, 2001; 3p; In English
Report No.(s): DE2001-784401; FERMILAB-CONF-01/154; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recently, it was proposed to use negatively charged electron beams for compensation of beam-beam effects due to protons in the Tevatron collider. We show that a similar compensation is possible in space-charge dominated low energy proton beams. The idea has a potential of several-fold increase of the FNAL Booster beam brightness. Best results will be obtained using three electron lenses around the machine circumference, using co-moving electron beam with time structure and profile approximately to the proton beam. This technique, if feasible, will be more cost effective than the straightforward alternative increasing the energy of the injection linac.
NTIS
*Particle Accelerators; Proton Beams*

**20020017540** Fermi National Accelerator Lab., Batavia, IL USA
**Experience with Magnetic Shielding of a Large Scale Accelerator**
Nagaitsev, S.; Aug. 14, 2001; 3p; In English
Report No.(s): DE2001-784345; FERMILAB-CONF-01/176-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

It is not unusual to place multiple accelerators in a common enclosure to save on civil construction costs. This often complicates operations, especially if accelerators are affecting each other. At Fermilab, the influence of a rapidly cycling Main Injector (MI) synchrotron on an antiproton storage ring (Recycler), placed in a common tunnel, was initially found to be unacceptable for a reliable operation of the Recycler. Initial closed orbit excursions in the Recycler ring during the MI ramp were in excess of 5 mm (rms). This paper describes a shielding technique, used to reduce these orbit excursions by a factor of five.
NTIS
*Injectors; Magnetic Shielding; Storage Rings (Particle Accelerators); Synchrotrons*

**20020017542** Fermi National Accelerator Lab., Batavia, IL USA
**Modeling of the Primary Proton Beamline of the Fermilab NuMI Project**
Striganov, S.; Aug. 14, 2001; 3p; In English
Report No.(s): DE2001-784339; FERMILAB-CONF-01/221-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The 120 GeV primary proton beamline for the NuMI-MINOS experiment at Fermilab will transport one of the most intense high-energy beams ever constructed. In parallel operation with the Collider program, 80% of the intensity capability of the

Fermilab Main Injector can be sent to NuMI. Radiation safety pertaining to residual activity, damage of equipment and irradiation of groundwater is a primary concern. A particular challenge is that this beam will be transported to and targeted in a cavern excavated in rock in an aquifer region. A model of the beamline, including transport elements and excavated enclosures, has been built in the radiation simulation program MARS. This model has been used to determine limits for allowable beam loss, and to study effects of instabilities and of various failure types. Some results obtained with this model are presented.
NTIS
*Radiation Protection; Particle Accelerators; Proton Beams; Computerized Simulation*

**20020017932** Stanford Linear Accelerator Center, CA USA
**Processing Studies of X-Band Accelerator Structures at the NLCTA**
Adolphsen, C.; Aug. 13, 2001; 4p; In English
Report No.(s): DE2001-787192; SLAC-PUB-8901; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
RF processing studies of 1.8-m X-band (11.4 GHz) traveling wave structure at the Next Linear Collider Test Accelerator (NLCTA) have revealed breakdown-related damage at gradients lower than expected from earlier tests with standing wave and shorter, lower group velocity traveling wave structures. To understand this difference, a series of structures with different group velocities and lengths are being processed. In parallel, efforts are being made to improve processing procedures and to reduce structure contaminants and absorbed gases. This paper presents results from these studies.
NTIS
*Linear Accelerators; Superhigh Frequencies*

**20020017936** Stanford Linear Accelerator Center, CA USA
**Intrabeam Scattering Analysis of ATF Beam Measurements**
Bane, K. L.; Jul. 25, 2001; 1p; In English
Report No.(s): DE2001-787188; SLAC-PUB-8875; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
At the Accelerator Test Facility (ATF) at KEK intrabeam scattering (IBS) is a strong effect for an electron machine. It is an effect that couples all dimensions of the beam, and in April 2000, over a short period of time, all dimensions were measured as functions of current. In this report we derive a simple relation for the growth rates of emittances due to IBS.
NTIS
*Scattering; Emittance*

**20020017968** Stanford Linear Accelerator Center, CA USA
**Developments in Beam-Based Alignment and Steering of the Next LInear Collider Main Linac**
Tenenbaum, P. G.; Jul. 27, 2001; 4p; In English
Report No.(s): DE2001-787207; SLAC-PUB-8933; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The Next Linear Collider main linacs are 13 km linear accelerators which each contain approximately 750 hybrid iron/permanent-magnet quadrupoles in a FODO array. The small amount of vertical emittance dilution permitted in the main linacs implies a tight tolerance on the RMS distance between the beam and the centers of the quads. We describe two methods for measuring the offsets between the quads and their integrated beam position monitors, and three algorithms for steering the main linac to minimize the emittance dilution. Simulation studies of the alignment and steering algorithms are presented.
NTIS
*Alignment; Beams (Radiation); Linear Accelerators; Computerized Simulation; Algorithms*

**20020017995** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Design of the CEBAF Energy Upgrade Cryomodule Cold Mass**
Hogan, J.; Campisi, R.; Delayen, J.; Getz, R.; Guerra, A.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783615; JLAB-ACE-01-03; DOE/ER/40150-1868; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The Jefferson Laboratory Energy Upgrade to 12 GeV will be accomplished by designing a new cryomodule with an increase in effective length of 40 percent while maintaining the same nominal cryomodule slot length within the linac. This is being achieved by changing from an eight five-cell cavity structure to an eight seven-cell cavity structure and removing all bellows between the cavities along the beamline. This approach has presented significant challenges with respect to the design as it pertains to the cooldown, support, alignment and tuning criteria. The solutions to these design challenges will be presented with an

emphasis on cavity operational criteria along with the integrated support components to include higher order mode couplers, fundamental power couplers and tuning accommodations for a one-hertz resolution.
NTIS
*Linear Accelerators; Cryogenics; Design Optimization*

**20020018021** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Fluence to Dose Equivalent Conversion Coefficients for Evaluation of Accelerator Radiation Environments**
Thomas, R. H.; Zeman, G. H.; Mar. 01, 2001; 19p; In English
Report No.(s): DE2001-785267; LBNL-47423; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The derivation of a set of conversion functions for the expression of neutron fluence measurements in terms of Effective Dose, E, is described. Four functions in analytical form are presented, covering the neutron energy range from 2.5 10-8 to 10+4 MeV, for the interpretation of fluence measurements in the typical irradiation conditions experienced around high-energy proton accelerators such as the Bevatron. For neutron energies below 200 MeV the analytical functions were modeled after the ISO and ROT conversion coefficients in ICRU 57. For neutron energies above 200 MeV, the analytical function was derived from an analysis of recent published data. Sample calculations using either the analytical expressions or the tabulated conversion coefficients from which the analytical expressions are derived show agreement to better than +/- 5%.
NTIS
*Synchrotrons; Radiation Dosage*

**20020018136** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Cumulative Beam Breakup in Linear Accelerators with Arbitrary Beam Current Profile**
Delayen, J. R.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783626; JLAB-ACP-01-04; DOE/ER/40150-1878; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An analytic formalism for the solution of cumulative beam breakup in linacs with arbitrary beam current profile is developed. It is applied to obtain an expression for the transverse displacement of trains of bunches of finite length. The same formalism is used to investigate the beam breakup-enhanced displacement of beams caused by the misalignment of the deflecting structures or focusing elements.
NTIS
*Linear Accelerators; Beam Currents*

**20020018192** Stanford Linear Accelerator Center, Stanford, CA USA
**Signals for Extra Dimensions at VLHC**
Rizzo, T. G.; Aug. 27, 2001; 4p; In English
Report No.(s): DE2001-787230; SLAC-PUB-8960; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There are now many models with extra spatial dimensions that predict the appearance of new physics signatures at colliders that can probe energy scales in excess of approximately 1 to a few TeV. These models generally fall into three distinct classes which lead to very different phenomenologies and collider signatures: (1) those based on the large extra dimensions scenario of Arkani-Hamed, Dvali, and Dimopoulos (ADD), which predicts the emission and exchange of large Kaluza-Klein (KK) towers of gravitons that are finely-spaced in mass; (2) those with TeV-scale dimensions (TeV), which predict the existence of KK excitations of the SM gauge (and possibly other) fields at the TeV scale and (3) those with warped extra dimensions, such as the Randall-Sundrum Model (RS); which predict graviton resonances with both weak scale masses and couplings to matter. The stage 2 Very Large Hadron Collider (VLHC) with a center of mass energy of approximately 175-200 TeV and a integrated luminosity in the range of 200-1000/fb will be able to search for and/or make detailed studies of models in all three classes. For most models of type (1) or (3) which deal with the hierarchy problem, if no signal is observed by the time the mass scales probed by the VLHC are reached, the motivation behind these particular models will be greatly weakened if not entirely removed. In what follows, for simplicity and in order to avoid potentially difficult detector issues associated with such high energies and luminosities, we will focus on searches involving only the simple Drell-Yan process pp e+e- yields X. From studies performed for the Tevatron and LHC we know that this channel provides an excellent probe of the parameter spaces of extra-dimensional models and we expect that this will continue to be true at even higher energies.
NTIS
*Luminosity; Particle Accelerators; Hadrons; Models*

**20020018193** Stanford Linear Accelerator Center, Stanford, CA USA

**Signals for Extra Dimensions at CLIC**

Rizzo, T. G.; Aug. 28, 2001; 4p; In English

Report No.(s): DE2001-787229; SLAC-PUB-8959; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Many models predict the existence of additional spatial dimensions that lead to new and distinct phenomenological signatures for future colliders which have center of mass energies in the TeV range and above. Most of the models in the literature fall into one the three following classes: (1) the large extra dimensions scenario of Arkani-Hamed, Dvali and Dimopoulos (ADD). This model predicts the emission and exchange of large Kaluza-Klein (KK) towers of gravitons that are finely-spaced in mass. The emitted gravitons appear as missing energy while the KK tower exchange leads to contact interaction-like dimension operators; and (2) A second possibility are models where the extra dimensions are of TeV scale in size.

NTIS

*Gravitons; Phenomenology; Linear Accelerators*

**20020018194** Stanford Linear Accelerator Center, Stanford, CA USA

**Sub-Picosecond Photon Pulse Facility for SLAC**

Cornacchia, M.; Aug. 28, 2001; 26p; In English

Report No.(s): DE2001-787228; SLAC-PUB-8950; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

It is possible to generate very bright sub-picosecond pulses of spontaneous x-ray radiation utilizing the electron beam from the SLAC linear accelerator and an undulator. The present injection-damping ring system used to inject into the PEP-II B-Factory can be used for this purpose, without any modification to the linear accelerator expect for a sequence of four bending magnets to compress the electron bunch. With a charge of 3.4 nC per bunch accelerated to 28 GeV and a 10 m long undulator, it is quite feasible to generate pulses of x-rays of 8.3 kV energy (in a spectrum extending to over 1 MeV), 80 fsec long (full-width-half-maximum), with a peak brightness of the order of 10(exp 25_ photons/sec/sq mm/sq mrad/0.1% bandwidth), and 10(exp 8) photons per pulse in a 0.1% bandwidth.

NTIS

*Electron Beams; Electron Bunching; Linear Accelerators; Photons; Picosecond Pulses; X Rays*

**20020018197** Stanford Linear Accelerator Center, Stanford, CA USA

**Room Temperature Accelerator Structures for Linear Colliders**

Miller, R. H.; Sep. 10, 2001; 5p; In English

Report No.(s): DE2001-787225; SLAC-PUB-8889; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Early tests of short low group velocity and standing wave structures indicated the viability of operating X-band linacs with accelerating gradients in excess of 100 MeV/m. Conventional scaling of traveling wave traveling wave linacs with frequency scales the cell dimensions with lambda.

NTIS

*Room Temperature; Linear Accelerators; Traveling Waves; Standing Waves*

**20020018198** Stanford Linear Accelerator Center, Stanford, CA USA

**Generation and Use of Coherent Transition Radiation from Short Electron Bunches**

Settakorn, C.; Aug. 28, 2001; 183p; In English

Report No.(s): DE2001-787223; SLAC-R-576; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This thesis concentrates on coherent transition and diffraction from short electron bunches as a potential high intensity far-infrared radiation source and for sub-picosecond electron bunch length measurements. Coherent transition radiation generated from a 25 MeV beam at a vacuum-metal interface is characterized. Such a high intensity radiation source allows far-infrared spectroscopy to be conducted conveniently with a Michelson interferometer and a room temperature detector. Measurements of the refractive index of silicon are described to demonstrate the possibilities of far-infrared spectroscopy using coherent transition radiation. Coherent diffraction radiation, which is closely related to coherent transition radiation, can be considered as another potential far infrared radiation source. Since the perturbation by the radiation generation to the electron beam is relatively small, its has the advantage of being a nondestructive radiation source.

NTIS

*Coherent Radiation; Electron Bunching; Radiation Sources*

**20020018200** Stanford Linear Accelerator Center, CA USA

**Sources of Beam Halo in the Next Linear Collider Main Linac**

Tenenbaum, P. G.; Jul. 27, 2001; 4p; In English

Report No.(s): DE2001-787209; SLAC-PUB-8935; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

One of the factors that limited the performance of the Stanford Linear Collider (SLC) was the number of particles per bunch with large betatron or energy amplitudes. We consider the equivalent problem for the Next Linear Collider (NLC) main X-band linacs. We evaluate the number of large-amplitude particles which can be expected due to scattering processes, wakefields, and magnet nonlinearities. We conclude that the number of particles in the beam halo from these sources can easily be accommodated by the planned post-linac collimation system.

NTIS

*Collimation; Linear Accelerators; Beams (Radiation); Halos; Superhigh Frequencies*

**20020018201** Stanford Linear Accelerator Center, CA USA

**Overview of Collimation in the Next Linear Collider**

Tenenbaum, P. G.; Jul. 27, 2001; 4p; In English

Report No.(s): DE2001-787208; SLAC-PUB-8934; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Next Linear Collider (NLC) requires a substantial system of beam collimators to minimize the halo-related backgrounds at the interaction point, provide machine protection against errant pulses, and limit radiation doses throughout the accelerator. In particular, the NLC design contains a complete 5-dimensional (x,x',y,y', energy) collimation system at the entrance and exit of the main linac; transverse collimators at the electron and positron sources, at the 250 MeV point in the injector linac, and immediately upstream of the damping rings; a series of collimators at points with substantial z-energy correlation for longitudinal collimation; and a final set of transverse and energy collimators in the final focus, a few hundred meters from the IP. We describe the systems above and estimate the intensity of the halo at each point, as well as the efficiency with which the halo is removed by the collimators.

NTIS

*Collimation; Linear Accelerators; Storage Rings (Particle Accelerators); Field Theory (Physics)*

**20020018570** Stanford Linear Accelerator Center, Stanford, CA USA

**Diffraction Dissociation in QCD and Light-Cone Wavefunctions**

Brodsky, S. J.; Sep. 20, 2001; 14p; In English

Report No.(s): DE2001-787241; SLAC-PUB-8998; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The diffractive dissociation of a hadron at high energies, by either Coulomb or Pomeron exchange, has a natural description in quantum chromodynamics (QCD) as the materialization of the projectile's light-cone wavefunctions - in particular, the diffractive dissociation of a meson, baryon, or photon into high transverse momentum jets measures the shape and other features of the projectile's distribution amplitude. Diffractive dissociation can thus test fundamental properties of QCD, including color transparency and intrinsic charm. All of these effects have an impact on exclusive decays of B mesons and the study of CP violation. I also recent work which shows that the structure functions measured in deep inelastic lepton scattering are affected by final-state rescattering, thus modifying their connection to light-cone probability distributions. In particular, the shadowing of nuclear structure functions is due to destructive interference effects from leading-twist diffraction of the virtual photon, physics not included in the nuclear light-cone wavefunctions.

NTIS

*Diffraction; Dissociation; Light-Cone Expansion; Quantum Chromodynamics; Wave Functions*

**20020018572** Stanford Linear Accelerator Center, Stanford, CA USA

**Comparative Study of Medium Damped and Detuned Linear Accelerator Structures**

Jones, R. M.; Sep. 14, 2001; 4p; In English

Report No.(s): DE2001-787238; SLAC-PUB-8993; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Long range wakefields are a serious concern for a future linear collider based on room temperature accelerating structures. They can be suppressed either by detuning and or local damping or with some combination of both strategies. Detuning relies on precisely phasing the contributions of the dipole modes excited by the passage of a single bunch. This is accomplished by controlling individual mode frequencies, a process which dictates individual cell dimensional tolerances. Each mode must be

excited with the correct strength; this in turn, determines cell-to-cell alignment tolerances. In contrast, in a locally damped structure, the modes are attenuated at the cell level.
NTIS
*Linear Accelerators; Room Temperature; Tuning; Damping*

**20020018574** Stanford Linear Accelerator Center, Stanford, CA USA
**Microbunching Due to Coherent Synchrotron Radiation in a Bunch Compressor**
Stupakov, G.; Sep. 10, 2001; 15p; In English
Report No.(s): DE2001-787236; SLAC-PUB-8988; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The coherent synchrotron radiation of a bunch in a bunch compressor may lead to the microwave instability producing longitudinal modulation of the bunch. This modulation generates coherent radiation with the wave length small compared to the bunch length. It can also be a source if an undesirable emittance growth in the compressor. We derive and analyze the equation that describes linear evolution of the microwave modulation. Numerical solution of this equation for the LCLS bunch compressor reveals such an instability, in qualitative agreement with numerical simulations.
NTIS
*Coherent Radiation; Compressors; Modulation*

**20020018576** Stanford Linear Accelerator Center, CA USA
**Photoinjector Design for the LCLS**
Clendenin, J.; Aug. 22, 2001; 13p; In English
Report No.(s): DE2001-787220; SLAC-PUB-8962; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The design of the Linac Coherent light Source assumes that a low-emittance, 1-nC, 10-ps beam will be available for injection into the 15-GeV linac. The proposed rf photocath hode injector that will meet this requirement is based on a 1.6-cell S-band rf gun equipped with an emittance compensating solenoid. The booster accelerator with a gradient of 25 MV/m is positioned at the beam waist coinciding with the first emittance maximum, i.e., the 'new working point.' The uv pulses required for cathode excitation will be generated by tripling the output of a Tisapphire laser system. Details of the design and the supporting simulations are presented.
NTIS
*Coherent Light; Light Sources; Linear Accelerators; Simulation; Photocathodes*

**20020018825** Stanford Linear Accelerator Center, CA USA
**Asset Test of the CLIC Accelerating Structure**
Adolphsen, C.; Jul. 31, 2001; 4p; In English
Report No.(s): DE2001-787212; SLAC-PUB-8941; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Transverse wakefield suppression in the CLIC (Compact Linear Collider) multibunch accelerating structure, called the TDS (Tapered Damped Structure), is achieved primarily through heavy damping. In order to verify the performance of the TDS design and the validity of the theoretical tools used to model it, a 15 GHz version of the TDS has been constructed and tested in the ASSET facility at SLAC. The test has directly demonstrated transverse wakefield suppression of over a factor 100, with an excellent agreement between the measured and the calculated wakefield.
NTIS
*Linear Accelerators; Mathematical Models; Damping; Performance Tests*

**20020018837** Stanford Linear Accelerator Center, CA USA
**Transverse Wakefields from Tapered Collimators: Measurements and Analysis**
Tenenbaum, P. G.; Jul. 27, 2001; 4p; In English
Report No.(s): DE2001-787211; SLAC-PUB-8937; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We report on a series of measurements of the transverse wakefield from tapered collimators. The collimators were designed to principally present a geometric impedance to the beam, and to minimize impedances from resistivity or surface features; in addition, the geometries of the collimators were selected to permit examination of the scaling behavior of the wakefield due to collimator taper angel and minimum gap size. We present the measured near-center wakefields of the collimators, as well as the effects of bunch-length variation. The measurements are compared to analytic models and MAFIA simulations.
NTIS
*Collimators; Mathematical Models; Electrical Resistivity; Computerized Simulation; Dimensional Analysis*

**20020018841** Stanford Linear Accelerator Center, CA USA

**Coherent Synchrotron Radiation Measurements in the CLIC Test Facility (CTF II)**

Kabel, A. C.; Aug. 09, 2001; 6p; In English

Report No.(s): DE2001-787216; SLAC-PUB-8949; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Bunches of high charge (up to 10 nC) are compressed in length in the CTF II magnetic chicane to less than 0.2 mm rms. The short bunches radiate coherently in the chicane magnetic field, and the horizontal and longitudinal phase space density distributions are effected. This paper reports the results of beam emittance and momentum, measurements. Horizontal and vertical emittances and momentum spectra were measured for different bunch compression factors and bunch charges. In particular, for 10 nC bunches, the mean beam momentum decreased by about 5% while the FWHM momentum spread increased from 5% to 19%. The experimental results are compared with simulations made with the code TraFiC(sup4).

NTIS

*Test Facilities; Synchrotron Radiation; Coherent Radiation; Emittance; Electron Bunching*

**20020020469** Oak Ridge National Lab., TN USA

**Overall Plan for Physics Outlining Steps Necessary for Insertion of the LTA and Operation Using a 1/3 MOX Loaded Core**

Pavlovichev, A. M.; Apr. 09, 2001; 25p; In English

Report No.(s): DE2001-779690; ORNL/SUB/00-85B99398V-1; No Copyright; Avail: Department of Energy Information Bridge

Document issued according to Work Release KI-WR04RTP. P. 00-1 describes physics tasks that are included in the current version of ”Roadmap Level 2” concerning Reactor tasks of Weapon-grade plutonium disposition problem for VVER-1000. On this base the objective is to identify the physical tasks in FY2000 and in future as a part of global activities on weapon-grade MOX fuel introduction into VVER-1000.

NTIS

*Plutonium; Reactor Physics*

## 74
## OPTICS

*Includes light phenomena and the theory of optical devices. For lasers see 36 Lasers and Masers.*

**20020016217** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Full-Order, Almost Deterministic Optical Matching Algorithm**

Chao, Y. C.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783607; JLAB-ACC-01-08; DOE/ER/40150-1860; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An algorithm was developed for beam envelope matching with fixed geometry, taking into account the full order behavior of the quadrupoles and their compounded effects. The algebraic complexity of the system has hitherto defied attempts to obtain global solutions in any deterministic manner. In the present approach an algorithm to systematically reduce the overall system of equations has resulted in a system of two 8th order equations in only two variables in the thin lens approximation, and a system of two 12th order equations in two variables in the semi-thin lens approximation. The former displays a high degree of robustness in providing true global solutions, while the latter can be deterministically iterated to approach the exact thick lens solution to very high accuracy, and can be applied to configurations with arbitrary non-dispersive intervening optics. At the numerical level these 2 reduced systems are input to an equation solver in Mathematica 4.0 based on Grobner-basis techniques, capable of providing global solutions to such algebraic systems. The combined application of these 2 systems of equations has resulted in a very robust and effective algorithm for on-line optical beam envelope matching. The global nature of the algorithm also may point to possible deficiencies in the optical system configuration when no solution in real numbers exists. This affords a higher degree of insight and confidence than is possible with local-root-searching algorithms. An on-line high precision transfer matrix measurement program was developed in conjunction to provide input to this algorithm. Preliminary on-line testing on the CEBAF accelerator at the Thomas Jefferson National Accelerator Facility has positively demonstrated the effectiveness of this method. Direction for further enhancement of the algorithm will also be discussed.

NTIS

*Algorithms; Display Devices; Matrices (Mathematics)*

**20020016218** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Synchronized FEL-Synchrotron Radiation Facility at Jefferson Lab**

Hutton, A.; Benson, S. V.; Dylla, H. F.; Garza, O.; Lauze, R. R.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783606; JLAB-ACC-01-07; DOE/ER/40150-1859; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Jefferson Lab is planning a facility for studying ultra-fast dynamic processes, which will have a 1 kW average power IR/UV FEL combined with a 1 nm critical wavelength electron storage ring. Light pulses from the 2 sources will be synchronized at 125 MHz for pump-probe studies in chemistry, physics, materials science, medicine and biology. The FEL operates with pulses as short as 300 femtoseconds, which will provide the narrow bandwidth pump at high peak as well as average power. The FEL is currently operating and will soon be upgraded to operate at 10 kilowatt average power at an extended wavelength range from 250 nm to 10,000 nm. A compact superconducting storage ring has recently been donated to Jefferson Lab, and is capable of stored currents up to 800 mA. In addition to providing spectroscopy capabilities, the storage ring will also support x-ray lithography R and D, including a precision stepper-aligner for training purposes. The facility, which is expected to become available in 200 4, will be described and the capabilities detailed.

NTIS

*Free Electron Lasers; Synchrotron Radiation; Storage Rings (Particle Accelerators); Ultraviolet Spectra*

**20020016410** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Symplectic models for general insertion devices**

Wu, Y.; Forest, E.; Robin, D. S.; Nishimura, H.; Wolski, A.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783876; LBNL-48177; No Copyright; Avail: Department of Energy Information Bridge

A variety of insertion devices (IDs), wigglers and undulators, linearly or elliptically polarized, are widely used as high brightness radiation sources at the modern light source rings. Long and high-field wigglers have also been proposed as the main source of radiation damping at next generation damping rings. As a result, it becomes increasingly important to understand the impact of IDs on the charged particle dynamics in the storage ring. In this paper, we report our recent development of a general explicit symplectic model for IDs with the paraxial ray approximation. High-order explicit symplectic integrators are developed to study real-world insertion devices with a number of wiggler harmonics and arbitrary polarizations.

NTIS

*Brightness; Radiation Sources; Light Sources*

**20020016436** Argonne National Lab., IL USA

**Laser strain gauge for accelerator targets**

Hassanein, A.; Norem, J.; Jul. 17, 2001; 2p; In English

Report No.(s): DE2001-783662; ANL-HEP-CP-01-67; No Copyright; Avail: Department of Energy Information Bridge

Multi megawatt accelerators can deliver sufficient power to a target to destroy it in a few pulses. In order to look at the response of solid and liquid targets under these high power pulses, we are developing optical methods of measuring surface deformations with time resolutions limited by laser pulse lengths. These methods can be used to examine the surfaces of solids and liquids during elastic deformation and unstable hydrodynamic flows. We present preliminary results of a system designed for target tests using the Brookhaven AGS and the Argonne CHM linac.

NTIS

*Particle Accelerator Targets; Strain Gages; Lasers*

**20020016451** Fermi National Accelerator Lab., Batavia, IL USA

**Trio of Modulators for the Fermilab Tevatron Electron Lens Project**

Wildman, D. W.; Jul. 25, 2001; 3p; In English

Report No.(s): DE2001-783395; FERMILAB-CONF-01/112-E; No Copyright; Avail: Department of Energy Information Bridge

Three high voltage modulators used during testing and operation of the Tevatron Electron Lens (TEL) at Fermilab will be described. Short high voltage (0 to approximately 20kV) pulses from these modulators vary the anode-cathode voltage of the TEL electron gun to control the magnitude of the electron beam current. The trio of modulators include a low repetition rate MOSFET-based pulser, a fast ionization device, and a high average power tetrode modulator. The characteristics of each device will be discussed and typical outputs from each type of modulator is shown.

NTIS

*Lenses; Modulators; Particle Accelerators*

**20020016463** Brookhaven National Lab., Upton, NY USA

**Statistical Correlations and Intensity Spiking in the SASE FEL**

Krinsky,; Gluckstern, L.; Sep. 19, 2001; 16p; In English

Report No.(s): DE2001-787628; BNL-68613; No Copyright; Avail: Department of Energy Information Bridge

In the linear regime before saturation, we describe the statistical correlations in the narrow band chaotic output of the self-amplification of spontaneous emission (SASE) free-electron laser (FEL). At a fixed position along the undulator axis, we derive joint probability distributions for the intensity in the output pulse to have values I(sub 1) and I(sub 2) at times t(sub 1) and t(sub 2), and for the spectral intensity to have values I(tilde)(sub 1) and I(tilde)(sub 2) at frequencies omega(sub 1) and omega(sub 2). Probability distributions for the peak values of intensity in the time and frequency domains are also determined.

NTIS

*Free Electron Lasers; Probability Distribution Functions; Statistical Correlation*

**20020016656** Bechtel Nevada Corp., Las Vegas, NV USA

**CVD Diamond Detectors for Current Mode Neutron Time-of-Flight Spectroscopy at OMEGA/NIF**

Schmid, G. J.; Glebov, V. Y.; Friensehner, A. V.; Hargrove, D. R.; Hatchett, S. P.; Jul. 01, 2001; 8p; In English

Report No.(s): DE2001-783912; DOE/NV/11718-590; W-7405-ENG-48; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have performed pulsed neutron and pulsed laser tests of a CVD diamond detector manufactured from DIAFILM, a commercial grade of CVD diamond. The laser tests were performed at the short pulse UV laser at Bechtel Nevada in Livermore, CA. The pulsed neutrons were provided by DT capsule implosions at the OMEGA laser fusion facility in Rochester, NY. From these tests, we have determined the impulse response to be 250 ps fwhm for an applied E-field of 500 V/mm. Additionally, we have determined the sensitivity to be 2.4 mA/W at 500 V/mm and 4.0 mA/W at 1000 V/mm. These values are approximately 2 to 5x times higher than those reported for natural Type IIa diamond at similar E-field and thickness (1 mm). These characteristics allow us to conceive of a neutron time-of-flight current mode spectrometer based on CVD diamond. Such an instrument would sit inside the laser fusion target chamber close to target chamber center (TCC), and would record neutron spectra fast enough such that backscattered neutrons and x-rays from the target chamber wall would not be a concern. The acquired neutron spectra could then be used to extract DD fuel areal density from the downscattered secondary to secondary ratio.

NTIS

*Vapor Deposition; Diamond Films; Neutron Spectrometers*

**20020016685** Brookhaven National Lab., Upton, NY USA

**Calibration of a vertical-scan long trace profiler at MSFC**

Gubarev,; Kester,; Takacs,; Jul. 31, 2001; 8p; In English

Report No.(s): DE2001-784211; BNL-68431; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The long trace profiler (LTP) is the instrument of choice for the surface figure measurement of grazing incidence mirrors. The modification of conventional LTP, the vertical-scan LTP, capable of measuring the surface figure of replicated shell mirrors is now in operation at Marshall Space Flight Center. A few sources of systematic error for vertical-scan LTP are discussed. Status of systematic error reduction is reported.

NTIS

*Mirrors; Calibrating; Grazing Incidence*

**20020016703** Department of Energy, Savannah River Site, Aiken, SC USA

**Interfacial Refraction Through Curved and Plane-Layered Media**

Kehoe, A. B.; Jul. 17, 2001; 103p; In English

Report No.(s): DE2001-783928; DPST-84-751; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two laser beam tracing codes, AXIAL and CYLINDER, have been written to determine a laser beam path through plane and cylindrical interfaces. For cylindrical interfaces, an equation set was derived which describes the path of the laser beam. For plane interfaces, it was not possible to derive a single equation set. Instead, it was necessary to divide the domain up into small elements or regions. The laser beam path was then determined by calculating the path of the laser beam through each region. AXIAL and CYLINDER can be used to determine where an LDA should be positioned so that velocity measurements can be made at a specified point.

NTIS

*Refraction; Laser Beams*

**20020016789** Sandia National Labs., Albuquerque, NM USA

**Exploiting lens technology through novel materials** ***Final Report***

Brooks, J. A.; Robino, C. V.; Griffith, M. L.; Headley, T. J.; Yang, N. C. Y.; Apr. 01, 2001; 74p; In English

Report No.(s): DE2001-784192; SAND2001-8186; No Copyright; Avail: Department of Energy Information Bridge

Laser Engineered Net Shaping (LENS) is a direct fabrication process in which metal powders are deposited into a laser melted pool, with succeeding layers being deposited to build up complex engineering shapes. This process is a rapid, low cost, low footprint, direct fabrication technique that lends itself to the concept for advanced manufacturing. It is especially suited for rapid prototyping and small lot production. However, previous work has developed LENS as an advanced manufacturing tool, rather than exploiting its potentially unique attributes. These attributes include: real time control of microstructure, tailored material properties at different locations in the same part, the production of graded thermal expansion parts, etc. In this program, the important metallurgical parameters, solidification velocity and cooling rate, have been characterized and process models developed that are being used as input to microstructural models. Residual stresses were measured and process maps developed for controlling residual stresses and melt pool size that are critical for controlling part dimensions and quality. Tool steels and two stainless steels have been used as model systems to demonstrate the concept and feasibility of utilizing the high solidification velocities and cooling rates to design microstructures and properties to meet functionality. It has also been shown that starting powder characteristics can greatly affect build quality, especially intralayer porosity. Limited work on ceramic materials indicates that novel material can be fabricated using this technology. This work has added a new dimension in designing and fabricating engineering components with novel microstructures and properties using this rapid prototyping technology.

NTIS

*Lasers; Lenses; Metal Powder*

**20020016902** Fermi National Accelerator Lab., Batavia, IL USA

**Studies of Photo-Emission and Field Emission in an RF Photo-Injector with a High Quantum Efficiency Photo-Cathode**

Hartung, W.; Aug. 10, 2001; 3p; In English

Report No.(s): DE2001-784270; FERMILAB-CONF-01/215-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An 18 MeV electron photo-injector facility was constructed at Fermilab in collaboration with UCLA, INFN-Milano, University of Rochester, and DESY. The photoinjector is now being operated in partnership with the Northern Illinois Center for Accelerator and Detector Development. The facility consists of an radio frequency (RF) gun with a cesium telluride (Cs2Te) photo-cathode excited by a pulsed ultraviolet (UV) laser, a nine-cell superconducting cavity, a magnetic chicane, and a beam line for experiments with the electron beam. The original goal was to produce a beam with high charge per bunch (8 nC) and low transverse emittance (approximately 20 mm mrad) in long bunch trains (800 bunches, 1 microseconds apart). The facility at Fermilab was used to develop, fabricate, and commission an RF gun for the TeSLA Test Facility Linac. This gun has been in use at DESY since November 1998, and its behavior is under study. A second RF gun was subsequently installed at Fermilab. Recent activities at Fermilab include studies of photo-injector dynamics and various experiments with the electron beam: electro-optic sampling of wake fields, plasma wake field acceleration, channeling radiation studies, and production of flat beams. Another major goal for the photo-injector was high QE and low field emission (dark current) from the gun (the latter being a source of unwanted radiation and unwanted background signals). Hence, in between the work outlined above, studies of the photo-emission and field emission behavior of the gun were carried out. The preliminary results will be summarized in this paper.

NTIS

*Field Emission; Injectors; Radio Frequencies; Electron Beams*

**20020017966** Amsterdam Univ., Netherlands

**Mid-Infrared Induced Energy Transfers in Si:Er** ***Final Report, 18 Sep. 2000 - 18 Sep 2001***

Gregorkiewicz, Tom, Amsterdam Univ., Netherlands; Oct. 16, 2001; 10p; In English

Contract(s)/Grant(s): N68171-00-M-6227

Report No.(s): AD-A396783; R/D-8840-EE-01; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Excitation and de-excitation mechanisms responsible for photoluminescence of Er(3+) ion in crystalline silicon were investigated by a variety of experimental techniques. Special emphasis was on the two-color time-resolved spectroscopy in the mid-infrared performed at a free-electron laser facility. Application of this technique for spectroscopic investigations of energy transfers within the Si:Er system has been originally proposed and developed in the team of the Principal Investigator. This unique experimental approach revealed that optical excitation of Er(3+) ion is a sequential two-stage process. Localization of a secondary particle, with a subsequent electron-pair recombination and energy transfer to the 4f-electron core, requires a prior capture of a primary particle by a local potential at an Er-related optically active center. Such a process is similar to exciton binding at

isoelectronic centers. Consequently, optical properties of a silver dopant representing this class of defects were investigated. In addition to the above, also more classical experimental techniques were used. Excitation spectroscopy in the infrared showed that Er-related emission at lambda 1.5 micrometers could be induced by photons with energies significantly lower than the bandgap of Si. Finally, by magneto-optical spectroscopy symmetry of the Er-related optical center dominant MBE-grown selectively Er-doped Si structures was found to be orthorhombic. In this was microscopic information on the structure of an optically active Er-related center in Si has been obtained in the most direct way.
DTIC
*Energy Transfer; Silicon; Erbium; Photonics; Photoluminescence*

**20020018048** Naval Research Lab., Chemistry Div., Washington, DC USA
**Bibliography of NRL Works on X-Ray Fluorescence Authored by L. S. Birks, D. B. Brown, J. W. Criss, H. Friedman, and J. V. Gilfrich**
Whitlock, Robert R.; Oct. 15, 2001; 30p; In English
Report No.(s): AD-A396966; NRL/MR/6175--01-8577; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The Naval Research Laboratory (NRL) has made significant contributions to the field of X-ray fluorescence (XRF) analysis. The calculational engine of the computer code NRLXRF still powers a significant fraction of commercial XRF analysis systems. The impact of these achievements was highlighted during the celebration of NRL's 75th Anniversary in preparation for which the top 75 technologies transferred by the Laboratory were selected. Quantitative X-ray Fluorescence Analysis was among the technologies so honored. This report presents a bibliography of the recipients of that award: LaVerne S. Birks, Dennis B. Brown, John W. Criss, John V. Gilfrich and Herbert Friedman. The extensive collection of publications by Friedman outside the field of XRF is available within the holdings of the NRL Ruth H. Hooker Research Library and Technical Information Center and is not included in this bibliography.
DTIC
*Bibliographies; X Ray Fluorescence; Quantitative Analysis*

**20020018054** European Office of Aerospace Research and Development, FPO New York, NY USA
**International Conference on Organic Nonlinear Optics (5th) ICONO'5 Held in Davos, Switzerland on March 12-16, 2000**
Mar. 16, 2000; 533p; In English
Report No.(s): AD-A396939; EOARD-CSP-00-5039; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche
The International Conference on Organic Nonlinear Optics ICONO'5 was interdisciplinary. Toics included: Crystal growth of organics, Poled polymers, Optical amplification, Wave mixing and phase conjugation, Fibers and wave guides, Photorefractive effects, Nonlinear optical information storage, Optical parallel processing, and Display applications of organic LEDs and spatial light modulators.
DTIC
*Nonlinear Optics; Light Modulators; Amplification; Crystal Growth; Light Emitting Diodes*

**20020018173** Brookhaven National Lab., Upton, NY USA
**Statistical correlations and intensity spiking in the SASE FEL**
Krinsjy,; Gluckstern, L.; Sep. 19, 2001; 16p; In English
Report No.(s): DE2001-787618; BNL-68613; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
In the linear regime before saturation, we describe the statistical correlations in the narrow band chaotic output of the SASE (self-amplified spontaneous emission) FEL (free-electron laser). At a fixed position along the undulator axis, we derive joint probability distributions for the intensity in the output pulse to have values I(sub 1) and I(sub 2) at times t(sub 1) and t(sub 2), and for the spectral intensity to have values (tilde I)(sub 1) and (tilde I)(sub 2) at frequencies (omega)(sub 1) and (omega)(sub 2). Probability distributions for the peak values of intensity in the time and frequency domains are also determined.
NTIS
*Free Electron Lasers; Spontaneous Emission*

**20020018568** Smithsonian Astrophysical Observatory, Cambridge, MA USA
**Ultra-Wideband Optical Modulation Spectrometer (OMS) Development: Study of the Optical Setup of a Wide-Band Optical Modulation Spectrometer** ***Final Report, 1 Mar. 2001 - 28 Feb. 2002***
Tolls, Volker, Smithsonian Astrophysical Observatory, USA; December 2001; 3p; In English
Contract(s)/Grant(s): NAG5-10476; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The purpose of this study is to advance the design of the optical setup for a wide-band Optical Modulation Spectrometer (OMS) for use with astronomical heterodyne receiver systems. This report describes the progress of this investigation achieved from March until December 2001.
Author
*Broadband; Heterodyning; Receivers; Spectrometers*

**20020018851** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**Laser Protection Using Liquid Crystal Devices** ***Laseskydd Med Vaeskekristallkomponenter***
Eliasson, H.; Evekull, D.; Kariis, H.; Jun. 2000; 112p; In Swedish
Report No.(s): PB2001-107752; FOA-R-00-01537-612-SE; Copyright; Avail: National Technical Information Service (NTIS)
Lasers are becoming common in both military and civilian life, due to the development of less expensive, smaller and more efficient laser systems. With more frequent use, the demand for protection against lasers increases. Lasers with high intensity and collimated beams can easily disturb or damage sensors or eyes. The protective measures used today consist mainly of spectral filters that attenuate the most common laser wavelengths. This will not be able to provide adequate protection in the future when lasers with unpredictable wavelengths have been developed. In this thesis, a characterization of the properties of some selected liquid crystal devices is reported. The properties evaluated are transmission, attenuation, switching time and spectrum. It is followed by an implementation of a laser protection system against continuous low-power lasers using nematic liquid crystal devices. The measurements have been made in the visual and a part of the infrared spectrum. The laser protection system implemented is documented in a demonstration film, where the threat consists of a switched continuous low-power laser. For protection against continuous low-power lasers, these devices are fast enough and attenuate the laser radiation to levels safe for the eye.
NTIS
*Lasers; Eye Protection; Liquid Crystals*

**20020018862** National Defence Research Establishment, Div. of Human Sciences, Linkoeping, Sweden
**Measurement and Low Light Performance with Leica Vector 4 Together with an Optical Enhancer** ***Maet och Skymningsegenskaper hos Leica Vector 4 Med Tillsatslptik***
Sandberg, S.; Oct. 1999; 34p; In Swedish
Report No.(s): PB2001-108137; FOA-R-99-01242-706-SE; No Copyright; Avail: National Technical Information Service (NTIS)
The Vector binoculars as well as the optical enhancer are characterized by a high optical quality. This is especially noticed when observing against the light and low light situations. However, classical optics, including the optical enhancer, have distinct limitations in darkness. The enhancer is advantageous when observing medium to high contrast targets, but not against low contrast targets in darkness. The Vector 4 laser lobe is well defined and corresponds to the square aiming reticle. The optical enhancer does not change that fact. Measurement through vegetation as well as in the vicinity of power lines and the horizon might demand a window of three aiming symbols, both with and without the enhancer. In good visibility it has been possible to measure distances between 4.5 km and 5.5 km with the enhancer and a kilometer less without it. The enhancer does reduce the divergence, but it also facilitates observation. The drawback is its weight. Vector 4 has a cool image color tone compared to Vector 1500 but the difference is of no major practical importance. The optical enhancer is color neutral and it maintains the binocular contrast characteristics.
NTIS
*Binoculars; Visibility; Color Vision; Contrast*

**20020018886** Alabama A & M Univ., Normal, AL USA
**Optical Sensors Based on Single Arm Thin Film Waveguide Interferometer**
Sarkisov, S. S., Alabama A & M Univ., USA; Diggs, D., Alabama A & M Univ., USA; Curley, M., Alabama A & M Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 12; In English; Also announced as 20020018881
Report No.(s): P4; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document
Single-arm double-mode double-order optical waveguide interferometer utilizes interference between two propagating modes of different orders. Sensing effect results from the change in propagation conditions of the modes caused by the environment. The waveguide is made as an open asymmetric slab structure containing a dye-doped polymer film onto a fused quartz substrate. It is more sensitive to the change of environment than its conventional polarimetric analog using orthogonal modes (TE and TM) of the same order. The sensor still preserves the option of operating in polarimetric regime using a variety

of mode combinations such as TE(sub 0)/TM(sub 0) (conventional), TE(sub 0)/TM(sub 1), TE(sub 1)/TM(sub 0), or TE(sub 1)/TM(sub 1) but can also work in nonpolarimetric regime using combinations TE(sub 0)/TM(sub 1) or TE(sub 0)/TM(sub 1). Utilization of different mode combinations simultaneously makes the device more versatile. Application of the sensor to gas sensing is based on doping polymer film with an organic indicator dye sensitive to a particular gas. Change of optical absorption spectrum of the dye caused by the gaseous pollutant results change of the reactive index of the dye-doped polymer film that can be detected by the sensor. As an indicator dyes, we utilize Bromocresol Purple doped into polymer poly(methyl) methacrylate, which shows a reversible growth of the absorption peak neat 600 nm after exposure to wet ammonia. We have built a breadboard prototype of the sensor with He-Ne laser as a light source and with a single mode fiber input and a multimode fiber output. The prototype showed sensitivity to temperature change of the order of 2 C per one full oscillation of the signal. The sensitivity of the sensor to the presence of wet ammonia is 200 ppm per one full oscillation of the signal. The further improvements include switching to a longer wavelength laser source (750-nm semiconductor laser), substitution of poly(methyl) methacrylate with hydrophilic high-temperature polyimide, and increase the doping rate of indicator dye. All these improvements are expected to bring sensitivity to 10 ppm of ammonia per one full oscillation of signal independent on the humidity of ambient air. The proposed sensor can be used as a robust and inexpensive stand-alone instrument for continuous environment pollution monitoring.
Author
*Optical Measuring Instruments; Thin Films; Waveguides; Interferometers; Propagation Modes*

**20020018897** Hampton Univ., Dept. of Physics, VA USA
**Design of Fiber Optic Sensors for Measuring Hydrodynamic Parameters**
Lyons, Donald R., Hampton Univ., USA; Quiett, Carramah, Hampton Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 24; In English; Also announced as 20020018881
Report No.(s): P16; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The science of optical hydrodynamics involves relating the optical properties to the fluid dynamic properties of a hydrodynamic system. Fiber-optic sensors are being designed for measuring the hydrodynamic parameters of various systems. As a flowing fluid makes an encounter with a flat surface, it forms a boundary layer near this surface. The region between the boundary layer and the flat plate contains information about parameters such as viscosity, compressibility, pressure, density, and velocity. An analytical model has been developed for examining the hydrodynamic parameters near the surface of a fiber-optic sensor. An analysis of the conservation of momentum, the continuity equation and the Navier-Stokes equation for compressible flow were used to develop expressions for the velocity and the density as a function of the distance along the flow and above the surface. When examining the flow near the surface, these expressions are used to estimate the sensitivity required to perform direct optical measurements and to derive the shear force for indirect optical measurements. The derivation of this result permits the incorporation of better design parameters for other fiber-based sensors. Future work includes analyzing the optical parametric designs of fiber-optic sensors, modeling sensors to utilize the parameters for hydrodynamics and applying different mixtures of hydrodynamic flow. Finally, the fabrication of fiber-optic sensors for hydrodynamic flow applications of the type described in this presentation could enhance aerospace, submarine, and medical technology.
Author
*Fiber Optics; Hydrodynamics; Computational Fluid Dynamics; Compressible Flow; Flow Velocity; Optical Measurement*

**20020018898** Hampton Univ., Dept. of Physics, VA USA
**The Fabrication of an Evanescent Field Sensor**
Lyons, Donald R., Hampton Univ., USA; Thompson, Erica J., Hampton Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 25; In English; Also announced as 20020018881
Report No.(s): P17; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We present current results concerning novel sensor-based applications for tilted angle fiber Bragg gratings summarized in a recently filed patent. In addition, concepts involving the coupling of light out of the core region of an optical fiber using ablated corrugations to induce interactions with the surrounding media will also be discussed. The interactions between the media and the coupled light formulate the sensing mechanism for both of these devices. The research illustrated here is an extension of previous work that investigated the affects of intense UV radiation fields on both SiO2 and Ge-doped SiO2-based structures (specifically optical fibers and preforms). Finally, these sensors were devised in order to satisfy an experimental task set forth by NASA Glenn involving the production of a prototype evanescent field sensor capable of real-time, dynamic index of refraction measurements as well as early (ultra-high sensitivity) detection of icing on airplane wings.
Author
*Evanescence; Bragg Gratings; Optical Fibers*

**20020018899** Hampton Univ., Dept. of Physics, VA USA

**Radiation Losses Due to Tapering of a Double-Core Optical Waveguide**

Lyons, Donald R., Hampton Univ., USA; Khet, Myat, Hampton Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 26; In English; Also announced as 20020018881

Report No.(s): P18; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The theoretical model we designed parameterizes the power losses as a function of .the profile shape for a tapered, single mode, optical dielectric coupler. The focus of this project is to produce a working model that determines the power losses experienced by the fibers when light crosses a taper region. This phenomenon can be examined using coupled mode theory. The optical directional coupler consists of a parallel, dual-channel, waveguide with minimal spacing between the channels to permit energy exchange. Thus, power transfer is essentially a function of the taper profile. to find the fields in the fibers, the approach used was that of solving the Helmholtz equation in cylindrical coordinates involving Bessel and modified Bessel functions depending on the location.

Author

*Optical Waveguides; Tapering; Coupling Circuits; Energy Transfer; Optical Relay Systems*

**20020018901** Hampton Univ., Dept. of Physics, VA USA

**Fiber Bragg Grating Filter High Temperature Sensors**

Lyons, Donald R., Hampton Univ., USA; Brass, Eric D., Hampton Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 28; In English; Also announced as 20020018881

Report No.(s): P20; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We present a scaled-down method for determining high temperatures using fiber-based Bragg gratings. Bragg gratings are distributed along the length of the optical fiber, and have high reflectivities whenever the optical wavelength is twice the grating spacing. These spatially distinct Bragg regions (located in the core of a fiber) are sensitive to local temperature changes. Since these fibers are silica-based they are easily affected by localized changes in temperature, which results in changes to both the grating spacing and the wavelength reflectivity. We exploit the shift in wavelength reflectivity to measure the change in the local temperature. Note that the Bragg region (sensing area) is some distance away from where the temperature is being measured. This is done so that we can measure temperatures that are much higher than the damage threshold of the fiber. We do this by affixing the fiber with the Bragg sensor to a material with a well-known coefficient of thermal expansion, and model the heat gradient from the region of interest to the actual sensor. The research described in this paper will culminate in a working device as well as be the second portion of a publication pending submission to Optics Letters.

Author

*Bragg Gratings; Temperature Sensors; High Temperature; Optical Fibers*

**20020019085** Physics and Electronics Lab. TNO, The Hague, Netherlands

**ARTEAM: A Ray Tracing Model for EO-Applications. A Background and Status Report** ***Final Report***

vanEijk, A. M. J., Physics and Electronics Lab. TNO, Netherlands; Kunz, G. J., Physics and Electronics Lab. TNO, Netherlands; July 2001; 62p; In English; Original contains color illustrations

Contract(s)/Grant(s): A99/KM/853; TNO Proj. 29456

Report No.(s): TD-2000-0269; FEL-00-A285; Copyright; Avail: Issuing Activity

The ARTEAM (Advanced Ray Tracing in the Earth's Atmosphere Module) computer code has been developed to assess the effect of refraction effects on long-range electro-optical surveillance systems. The module is coupled to micro-meteorological (TARMOS), molecular (MODTRAN) and aerosol (MPN, NAM) modules that allow assessment of the reduction in target irradiance due to atmospheric effects. The module is user-friendly and operates on a PC in Windows environment. Future efforts consists of implementation of a dedicated near-sea surface module and the coupling with the Netherlands Organization for Applied Scientific Research (TNO) electro-optical Technical Decision Aid (TDA) that is under construction.

Author

*Earth Atmosphere; Mathematical Models; Electro-Optics; Modules; Ray Tracing; Computer Programs*

**20020020429** NASA Marshall Space Flight Center, Huntsville, AL USA

**Tunable Optical Properties of Metal Nanoparticle Sol-Gel Composites**

Smith, David D., NASA Marshall Space Flight Center, USA; Snow, Lanee A., Alabama Univ., USA; Sibille, Laurent, Universities Space Research Association, USA; Ignont, Erica, Alabama Univ., USA; Journal of Non-Crystalline Solids; [2001]; ISSN 0022-3093; Volume 285, pp. 256-263; In English; Copyright; Avail: Issuing Activity

We demonstrate that the linear and non-linear optical properties of sol-gels containing metal nanoparticles are highly tunable with porosity. Moreover, we extend the technique of immersion spectroscopy to inhomogeneous hosts, such as aerogels, and determine rigorous bounds for the average fractional composition of each component, i.e., the porosity of the aerogel, or equivalently, for these materials, the catalytic dispersion. Sol-gels containing noble metal nanoparticles were fabricated and a significant blue-shift in the surface plasmon resonance (SPR) was observed upon formation of an aerogel, as a result of the decrease in the dielectric constant of the matrix upon supercritical extraction of the solvent. However, as a result of chemical interface damping and aggregation this blue-shift does not strictly obey standard effective medium theories. Mitigation of these complications is achieved by avoiding the use of alcohol and by annealing the samples in a reducing atmosphere.
Author
*Aerogels; Optical Properties; Porosity; Gels*

## 75
## PLASMA PHYSICS

*Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.*

**20020016123** Princeton Univ., Plasma Physics Lab., NJ USA
**Enhancement of Mode-converted Electron Bernstein Wave Emission during NSTX H-mode Plasmas**
Taylor, G.; Efthimion, P. C.; Jones, B.; LeBlanc, B. P.; Maingi, R.; Aug. 20, 2001; 16p; In English
Report No.(s): DE2001-787904; PPPL-3598; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A sudden, threefold increase in emission from fundamental electrostatic electron Bernstein waves (EBW) which mode convert and tunnel to the electromagnetic X-mode has been observed during H-mode (high-confinement mode) transitions on the National Spherical Torus Experiment (NSTX) spherical torus plasma. The mode-converted EBW emission viewed normal to the magnetic field on the plasma midplane increases when the density profile steepens in the vicinity of the mode-conversion layer, which is located in the plasma scrape off. The measured conversion efficiency during the H-mode is consistent with the calculated EBW to X-mode conversion efficiency derived using edge density data. Calculations indicate that there may also be a small residual contribution to the measured X-mode electromagnetic radiation from polarization-scrambled, O-mode emission, converted from EBWs.
NTIS
*Electron Emission; Electrostatic Waves; Plasmas (Physics); Augmentation*

**20020016124** Princeton Univ., Plasma Physics Lab., NJ USA
**Physics of Compact Advanced Stellarators**
Zarnstorff, M. C.; Berry, L. A.; Brooks, A.; Fredrickson, E.; Fu, G. Y.; Aug. 14, 2001; 32p; In English
Report No.(s): DE2001-787903; PPPL-3597; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Compact optimized stellarators offer novel solutions for confining high-beta plasmas and developing magnetic confinement fusion. The 3-D plasma shape can be designed to enhance the MHD stability without feedback or nearby conducting structures and provide drift-orbit confinement similar to tokamaks. These configurations offer the possibility of combining the steady-state low-recirculating power, external control, and disruption resilience of previous stellarators with the low-aspect ratio, high beta-limit, and good confinement of advanced tokamaks. Quasi-axisymmetric equilibria have been developed for the proposed National Compact Stellarator Experiment (NCSX) with average aspect ratio 4-4.4 and average elongation of approximately 1.8. Even with bootstrap-current consistent profiles, they are passively stable to the ballooning, kink, vertical, Mercier, and neoclassical-tearing modes for beta > 4%, without the need for external feedback or conducting walls. The bootstrap current generates only 1/4 of the magnetic rotational transform at beta = 4% (the rest is from the coils), thus the equilibrium is much less nonlinear and is more controllable than similar advanced tokamaks. The enhanced stability is a result of "reversed" global shear, the spatial distribution of local shear, and the large fraction of externally generated transform. Transport simulations show adequate fast-ion confinement and thermal neoclassical transport similar to equivalent tokamaks. Modular coils have been designed which reproduce the physics properties, provide good flux surfaces, and allow flexible variation of the plasma shape to control the predicted MHD stability and transport properties.
NTIS
*Stellarators; Plasmas (Physics); Magnetohydrodynamic Stability; Fusion (Melting); Three Dimensional Models*

**20020016126** Army Armament Research, Development and Engineering Center, Benet Labs., Watervliet, NY USA

**Origins of Beta Tantalum in Sputtered Coatings** ***Final Report***

Mulligan, C. P.; Nov. 2001; 15p; In English

Report No.(s): AD-A396715; ARCCB-TR-01022; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The source of beta tantalum formation in sputtered coatings has been a subject of controversy going back over thirty years. For every research paper in which the cause is seemingly identified, there are others, which seem to disprove it. It has been very difficult to find a unifying theory that explains the contradictory results found in these papers. The purpose of this report is to compile the vast amount of information gathered from the literature so that connections can be made between the many parameters involved. Some of the most recent work has attempted to relate the energetics (i.e., atom/ion energy) of the plasma to the alpha right arrow beta transition. It has been shown that the energetics of the plasma can relate to the most crucial sputtering parameters. The most significant feature of the use of plasma energy to explain the alpha right arrow beta transition is that it relates the formation of beta-tantalum to a quantifiable measure.

DTIC

*Protective Coatings; Plasmas (Physics); Tantalum*

**20020016129** General Atomics Co., San Diego, CA USA

**Systematic Characterization of Component Failures for the DIII-D Tokamak**

Petersen, P. I., General Atomics Co., USA; Aug. 01, 1999; 18p; 5th International Symposium on Fusion Nuclear Technology, 19-24 September 1999, Rome, Italy

Contract(s)/Grant(s): AC03-99ER54463

Report No.(s): DE2001-766880; GA-A23178; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A fusion reactor will be a fairly complex system consisting of many components. All the components are required to work in order to produce a plasma and control it. Some of the components will be large, and for economic reasons there will not be spares for the components. It is therefore important to have a system whereby troubles are communicated, recorded and analyzed. Such a trouble report system has been in place at the DIII-D tokamak facility for many years. The purpose of the system is to easily facilitate communication between the people that discover problems and those that fix the problems. The trouble sheets are logged into a computer database that is used to characterize the kind of problems that the facility experiences, and determine which equipment, software, or human errors are causing significant downtime. The information is also used to evaluate whether sufficient maintenance is done to the equipment and to provide a basis for replacing it. The original system was based on paper forms. About a year ago the system was changed to web-based system. In the new system a trouble report is filled out using a web browser, and the information is emailed to the repair personnel and managers as soon as the form is submitted through the web. The paper will discuss the problems experienced at the DIII-D facility, and how the information is used to adjust the preventive maintenance schedule.

NTIS

*Complex Systems; Plasma Control; Preventive Maintenance; Tokamak Devices*

**20020016130** General Atomics Co., San Diego, CA USA

**DIII-D Advanced Tokamak Research Overview**

Chan, V. S.; Greenfield, C. M.; Lao, L. L.; Luce, T. C.; Petty, C. C.; Dec. 01, 1999; 11p; In English; 2nd IAEA Technical Committee Meeting on Steady State Operation of Magnetic Fusion Devices, 25-29 Oct. 1999, Fukuoka, Japan

Contract(s)/Grant(s): AC03-99ER5446; FG03-95ER54294; FG03-86ER53225; AC02-76CH03073; AC04-94AL85000; AC05-96OR22464; W-7405-ENG-48

Report No.(s): DE2001-766827; GA-A23312; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper reviews recent progress in the development of long-pulse, high performance discharges on the DIII-D tokamak. It is highlighted by a discharge achieving simultaneously BNH of 9, bootstrap current fraction of 0.5, noninductive current fraction of 0.75, and sustained for 16 energy confinement times. The physics challenge has changed in the long-pulse regime. Non-ideal MHD modes are limiting the stability, fast ion driven modes may play a role in fast ion transport which limits the stored energy and plasma edge behavior can effect the global performance. New control tools are being developed to address these issues.

NTIS

*Plasma Control; Tokamak Devices; Toroidal Discharge; Magnetohydrodynamic Stability*

**20020016131** General Atomics Co., San Diego, CA USA

**Modeling of Trapped Electron Effects on Electron Cyclotron Current Drive for Recent DIII-D Experiments**

Lin-Liu, Y. R.; Sauter, O.; Harvey, R. W.; Chan, V. S.; Luce, T. C.; Aug. 01, 1999; 7p; 26th European Conference on Controlled

Fusion and Plasma Physics, 14-16 June, 1999, Maastricht, Netherlands
Contract(s)/Grant(s): AC03-99ER54463
Report No.(s): DE2001-766825; GA-A23161; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Owing to its potential capability of generating localized non-inductive current, especially off-axis, Electron Cyclotron Current Drive (ECCD) is considered a leading candidate for current profile control in achieving Advanced Tokamak (AT) operation. In recent DIII-D proof-of-principle experiments, localized off-axis ECCD has been clearly demonstrated for first time. The measured current drive efficiency near the magnetic axis agrees well with predictions of the bounce-average Fokker-Planck theory. However, the off-axis current drive efficiency was observed to exceed the theoretical results, which predict significant degradation of the current drive efficiency due to trapped electron effects. The theoretical calculations have been based on an assumption that the effective collision frequency is much smaller than the bounce frequency such that the trapped electrons are allowed to complete the banana orbit at all energies. The assumption might be justified in reactor-grade tokamak plasmas, in which the electron temperature is sufficiently high or the velocity of resonant electrons is much larger than the thermal velocity, so that the influence of collisionality on current drive efficiency can be neglected. For off-axis deposition in the present-day experiments, the effect of high density and low temperature is to reduce the current drive efficiency, but the increasing collisionality reduces the trapping of current-carrying electrons, leading to compensating increases in the current drive efficiency. In this work, we use the adjoint function formulation to examine collisionality effects on the current drive efficiency.
NTIS
*Tokamak Devices; Trapped Particles*

**20020016132** General Atomics Co., San Diego, CA USA
**Resistive Wall Mode Feedback Control System on DIII-D**
Scoville, J. T.; Kellman, D. H.; Pronko, S. G. E.; Nerem, A.; Hatcher, R.; Nov. 01, 1999; 7p; In English; 18th IEEE/NPSS Symposium on Fusion Engineering, 25-29 Oct. 1999, Albuquerque, NM, USA
Contract(s)/Grant(s): AC03-99ER54463; AC02-76CH03073
Report No.(s): DE2001-766806; GA-A23256; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

One of the primary instabilities limiting the performance of the plasma in advanced tokamak operating regimes is the resistive wall mode (RWM). The most common RWM seen in the DIII-D tokamak is originated by an n=1 ideal external kink mode which, in the presence of a resistive wall, is converted to a slowly growing RWM. The mode causes a reduction in plasma rotation, a loss of stored energy, and sometimes leads to plasma disruption. It routinely limits the performance of a tokamak operating near reactor relevant parameter levels. A system designed to actively control the RWM has recently been installed on the DIII-D tokamak for the control of low m n=1 modes. In initial experiments, the control system has been capable of delaying the onset of RWMs in energetic discharges for several hundred milliseconds. The feedback control system consists of detector coils connected via control software to high power current amplifiers driving the excitation coils. The three pairs of excitation coils are each driven by a current amplifier and a DC power supply. The control signal is derived from a set of six sensor coils that measure radial flux as low as one Gauss. The signals are digitally processed by realtime software in the DIII-D Plasma Control System (PCS) to create a command that is sent to the current amplifier, with a cycle time of approximately 100 (micro)s. The amplifiers, designed and fabricated by Robicon Corporation to a specification developed by PPPL and GA, are bipolar devices capable of (+-)5 kA at 300 V, with an operating bandwidth of approximately 800 Hz (-3 dB).
NTIS
*Plasma Control; Tokamak Devices; Plasma Loss; Feedback Control*

**20020016133** General Atomics Co., San Diego, CA USA
**Modification of H-Mode Pedestal Instabilities in the DIII-D Tokamak**
Ferron, J. R.; Chu, M. S.; Jackson, G. L.; Lao, L. L.; Miller, R. L.; Nov. 01, 1999; 28p; In English; 41st Annual Meeting of the Division of Plasma Physics, 15-19 Nov. 1999, Seattle, WA, USA
Contract(s)/Grant(s): AC03-99ER54463; W-7405-ENG-48; AC05-96OR22464; AC02-76CH03073; FG02-89ER53297
Report No.(s): DE2001-766748; GA-A23303; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Through comparison of experiment and ideal magnetohydrodynamic (MHD) theory, modes driven in the edge region of tokamak H-mode discharges (Type I edge-localized modes (ELMs)) are shown to result from low toroidal mode number (n) instabilities driven by pressure gradient and current density. The mode amplitude and frequency are functions of the discharge shape. Reductions in mode amplitude are observed in discharge shapes with either high squareness or low triangularity where the low-n stability threshold in the edge pressure gradient is predicted to be reduced and the most unstable mode is expected to have higher values of n. The importance of access to the ballooning mode second stability regime is demonstrated through the changes

in the ELM character that occur when second regime access is not available. An edge stability model is presented that predicts that there is a threshold value of n for second regime access and that the most unstable mode has n near this threshold.
NTIS
*Magnetohydrodynamic Stability; Tokamak Devices; Plasma Control*

**20020016135** General Atomics Co., San Diego, CA USA
**Control of the Resistive Wall Mode in Advanced Tokamak Plasmas on DIII-D**
Garofalo, A. M.; Strait, E. J.; Bialek, J.; Frederickson, E.; Gryaznevich, M.; Nov. 01, 1999; 19p; In English
Report No.(s): DE2001-766647; GA-A23272; No Copyright; Avail: Department of Energy Information Bridge

Resistive wall mode (RWM) instabilities are found to be a limiting factor in advanced tokamak (AT) regimes with low internal inductance. Even small amplitude modes can affect the rotation profile and the performance of these ELMing H-mode discharges. Although complete stabilization of the RWM by plasma rotation has not yet been observed, several discharges with increased beam momentum and power injection sustained good steady-state performance for record time extents. The first investigation of active feedback control of the RWM has shown promising results: the leakage of the radial magnetic flux through the resistive wall can be successfully controlled, and the duration of the high beta phase can be prolonged. The results provide a comparative test of several approaches to active feedback control, and are being used to benchmark the analysis and computational models of active control.
NTIS
*Active Control; Mathematical Models; Plasmas (Physics); Tokamak Devices; Walls; Magnetohydrodynamic Stability*

**20020016136** Princeton Univ., Plasma Physics Lab., NJ USA
**Parallel Two-fluid Code for Global Magnetic Reconnection Studies**
Breslau, J. A.; Jardin, S. C.; Aug. 09, 2001; 23p; In English
Report No.(s): DE2001-787906; PPPL-3600; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes a new algorithm for the computation of two-dimensional resistive magnetohydrodynamic (MHD) and two-fluid studies of magnetic reconnection in plasmas. It has been implemented on several parallel platforms and shows good scalability up to 32 CPUs for reasonable problem sizes. A fixed, nonuniform rectangular mesh is used to resolve the different spatial scales in the reconnection problem. The resistive MHD version of the code uses an implicit/explicit hybrid method, while the two-fluid version uses an alternating-direction implicit (ADI) method. The technique has proven useful for comparing several different theories of collisional and collisionless reconnection.
NTIS
*Magnetohydrodynamics; Algorithms; Two Dimensional Models; Magnetic Field Reconnection; Plasmas (Physics)*

**20020016161** General Atomics Co., San Diego, CA USA
**Effect of Plasma Shape on H-Mode Pedestal Characteristics on DIII-D**
Osborne, T. H.; Ferron, J. R.; Groebner, R. J.; Lao, L. L.; Leonard, A. W.; Dec. 01, 1999; 21p; In English; 4th IAEA Technical Committee Meeting on H-Mode and Transport Barrier, 27-29 Sept. 1999, Oxford, UK
Contract(s)/Grant(s): AC03-99ER54463; AC05-96OR22464; AC04-94AL85000
Report No.(s): DE2001-766744; GA-A23273; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The characteristics of the H-mode are studied in discharges with varying triangularity and squareness. The pressure at the top of the H-mode pedestal increases strongly with triangularity primarily due to an increase in the margin by which the edge pressure gradient exceeds the ideal ballooning mode first stability limit. Two models are considered for how the edge may exceed the ballooning mode limit. In one model (1), access to the ballooning mode second stable regime allows the edge pressure gradient and associated bootstrap current to continue to increase until an edge localized, low toroidal mode number, ideal kink mode is destabilized. In the second model (2), the finite width of the H-mode transport barrier, and diamagnetic effects raise the pressure gradient limit above the ballooning mode limit. We observe a weak inverse dependence of the width of the H-mode transport barrier, (Delta), on triangularity relative to the previously obtained (3) scaling (Delta) (infinity) ((beta)(sub P)(sup PED))(sup 1/2). The energy loss for Type I ELMs increases with triangularity in proportion to the pedestal energy increase. The temperature profile is found to respond stiffly to changes in T(sup PED) at low temperature, while at high temperature the response is additive. The response of the density profile is also found to play a role in the response of the total stored energy to changes in the W(sup PED).
NTIS
*Plasma Control; Ballooning Modes*

**20020016162** General Atomics Co., San Diego, CA USA

**Progress Toward Long Pulse, High Performance Plasmas in the DIII-D Tokamak**

Politzer, P. A.; Luce, T. C.; Austin, M. E.; Garofalo, A. M.; Ferron, J. R.; Feb. 01, 2000; 14p; In English

Report No.(s): DE2001-766730; GA-A23329; No Copyright; Avail: Department of Energy Information Bridge

A major portion of the research program of the DIII-D tokamak collaboration is devoted to the development and demonstration of high performance advanced tokamak plasmas, with profiles as close as possible to those anticipated for steady-state operation. The work during the 1999 campaign has resulted in significant progress toward this goal. High normalized performance ((beta)(sub N) (approx) 4 and (beta)(sub N) H(sub 89) (approx) 9) discharges have been sustained for up to 2 s. These plasmas are in H-mode with rapid ELMs. The most common limiting phenomena are resistive wall modes (RWMs) rather than neoclassical tearing modes (NTMs). NTMs do occur, apparently triggered by the RWMs. The observed pressure is well above the calculated beta limit without a wall, and (beta)(sub N) greater than 4 (ell)(sub i) throughout the high performance phase. The bootstrap current is estimated to be greater than 50% of the total, and measurements of the internal loop voltage show that only about 25% of the current is inductively driven. The central q profile is flat, as is the calculated bootstrap current profile, due to the absence of any localized pressure gradients. The residual inductive current is localized around r/a (approx) 0.5. to demonstrate quasi-stationary operation, it will be necessary to replace the residual inductive current with ECCD at the same minor radius. to effectively apply ECH and ECCD to these discharges, density control will be needed. Preliminary experiments using the DIII-D cryopump have reduced the density by (approx)20%. A new EC power system and a new private flux cryopump will be available for the 2000 campaign.

NTIS

*Plasmas (Physics); Tokamak Devices; Cryogenics; Performance Tests; Pulse Amplitude*

**20020016163** General Atomics Co., San Diego, CA USA

**Physics of Confinement Improvement with Impurity Seeding in DIII-D**

Murakami, M.; McKee, G. R.; Jackson, G. L.; Staebler, G. M.; Baker, D. R.; Aug. 01, 2000; 7p; In English

Report No.(s): DE2001-766728; GA-A23443; No Copyright; Avail: Department of Energy Information Bridge

Clear increases in confinement (from H(sub 89P) (approx) 1 to H(sub 89P) greater than or equal to 2) and simultaneous reductions of long-wavelength turbulence have been observed in L-mode discharges in DIII-D, which are directly correlated with external impurity injection (1). These observations provide an opportunity to understand the mechanism for confinement improvement with impurity seeding observed in a number of tokamaks (2), and to make quantitative tests of theory-based turbulence and transport models with experimental measurements. Impurity seeding can be used not only to produce a radiative mantle to reduce heat fluxes to the first wall material (3), but also as a tool to control profiles in Advanced Tokamak (AT) plasmas. Significant confinement improvements are observed with injection of noble gases (Ne, Ar, and Kr) into L-mode edge, negative central shear (sawtooth-free) discharges in DIII-D. Compared to similar reference discharges without impurity injection, confinement enhancement factor and neutron emission in neon-injected discharges are nearly doubled (Fig. 1(a,b)). The ion and electron temperature with neon injection exhibit increased central values and profile broadening while the electron density profile becomes more peaked.

NTIS

*Impurities; Plasmas (Physics); Plasma Control; Tokamak Devices; Gas Injection; Rare Gases*

**20020016164** General Atomics Co., San Diego, CA USA

**Turbulent Radial Correlation Lengths in the DIII-D Tokamak**

Rhodes, T. L.; Leboeuf, J. N.; Sydora, R.; Doyle, E. J.; Moyer, R. A.; Aug. 01, 2000; 7p; In English

Report No.(s): DE2001-766721; GA-A23419; No Copyright; Avail: Department of Energy Information Bridge

Measurements of the radial correlation length Ar of density fluctuations have been made on the DIII-D tokamak in a variety of L-mode discharges. These measurements span the radial region 0.5 less than (rho) less than or equal to 1 and are found to scale approximately as (rho)(sub (theta),s) or 5-10 (rho)(sub s). Here (rho)(sub (theta),s) is the poloidal ion Larmor radius calculated using local T(sub e) and poloidal magnetic field and (rho)(sub s) is the same except calculated using the total magnetic field. The (Delta)r data were obtained from a heterodyne reflectometer system. Comparisons to published analytic formulas of Ar have been carried out for a particular discharge condition. The measurements are found to be comparable in magnitude and radial dependence with a slab type formulation of ion temperature gradient (ITG) driven turbulence as well as an electron drift wave turbulence type prediction. Predictions from toroidal ITG and a different slab ITG model were found to be outside the error bars of the measurements. In addition, a detailed comparison to a non-linear gyro-kinetic turbulence code has begun. These and other similar

comparisons are believed to be important as they serve to test and benchmark theory and codes as well as to help identify the type(s) of turbulence involved.
NTIS
*Tokamak Devices; Turbulence; Correlation; Larmor Radius; Plasmas (Physics); Length*

**20020016165** General Atomics Co., San Diego, CA USA
**Resistive Wall Mode Feedback Stabilization Experiment on DIII-D**
Okabayashi, M.; Bialek, J.; Chance, M. S.; Chu, M. S.; Fredrickson, E.; Aug. 01, 1999; 7p; In English
Report No.(s): DE2001-766708; GA-A23169; No Copyright; Avail: Department of Energy Information Bridge
The feedback stabilization of the Resistive Wall Mode (RWM) has begun in the DIII-D Tokamak. The main objective of the experiment is to stabilize the RWM by effecting a 'perfectly' conducting shell through active compensation of the n = 1 flux leaking through the resistive vacuum vessel. The preliminary results indicate that the n = 1 flux leakage from the vacuum vessel can indeed be compensated by the feedback system, and the amplitude of the magnetohydrodynamic mode can be reduced and the discharge's duration prolonged with a judicious choice of feedback parameters. We briefly describe the initial experimental results and also summarize a new feedback simulation code in toroidal geometry, which should prove useful for better understanding of the RWM feedback process.
NTIS
*Magnetohydrodynamic Stability; Tokamak Devices; Plasma Control; Feedback Control*

**20020016166** General Atomics Co., San Diego, CA USA
**Studies of H-Mode Plasmas Produced Directly by Pellet Injection in the DIII-D Tokamak**
Gohil, P.; Baylor, L. R.; Jernigan, T. C.; Burrell, K. H.; Carlstrom, T. N.; Aug. 01, 2000; 7p; In English
Report No.(s): DE2001-766706; GA-A23420; No Copyright; Avail: Department of Energy Information Bridge
A key issue for the physics of H-mode plasmas is to determine which plasma quantities are critical for the formation of the edge transport barrier. One approach is to directly perturb the edge plasma and observe the subsequent changes. In DIII-D, pellet injection has been used to directly change the edge plasma conditions and produce H-mode transitions. One hypothesis for the H-mode transition is that the attainment of a critical edge electron temperature is required for the transition (1-3). This hypothesis is disproved in this paper. H-mode transitions were produced by injecting frozen deuterium pellets of diameter 2.7 mm from the inner wall of the DIII-D vessel into the high toroidal field side (HFS) and from the outer wall into the low field side (LFS) of the plasma. Both the HFS and LFS pellets produced significant increases in the edge electron density, which led to substantial reductions in the edge electron and ion temperatures. However, H-mode transitions were still produced with the lowered edge temperatures, implying that a critical edge temperature is not necessary for H-mode transitions. The pellet induced H-mode plasma exhibited clear pedestals in electron density and electron and ion temperatures at the plasma edge and persisted for the duration of the applied neutral beam power. The HFS pellet's penetration and deposition profiles were substantially deeper (up to (rho) (approx) 0.2) than that of the LFS pellet (up to (rho) (approx) 0.7). However, since both HFS and LFS pellets produced H-mode transitions, this implies that pellet penetration depth is not important the important factor is the large increase in the electron density right at the plasma edge produced by both types of pellets. The values of the edge plasma quantities at the H-mode transition were expressed in the parametric terms described in several theories and models of the H-mode transitions (4-6). On comparison, the experimentally determined parameters at the H-mode transition were well below those required by several theoretical models. Finally, pellet injection reduced the neutral beam power required to produce the H-mode from 7.3 MW to 4.9 MW in plasmas which had the (del)B drift away from the X-point.
NTIS
*Injection; Mathematical Models; Pellets; Plasmas (Physics); Tokamak Devices; Deuterium*

**20020016167** General Atomics Co., San Diego, CA USA
**High Density H-Mode Discharges with Gas Fueling and Good Confinement on DIII-D**
Leonard, A. W.; Osborne, T. H.; Mahdavi, M. A.; Fenstermacher, M. E.; Lasnier, C. J.; Aug. 01, 2000; 7p; In English
Report No.(s): DE2001-766692; GA-A23418; No Copyright; Avail: Department of Energy Information Bridge
H-mode operation at high density is an attractive regime for future reactor-grade tokamaks (1). High density maximizes fusion power output while the high confinement of H-mode keeps the plasma energy loss below the alpha heating power. One concern though is the energy released due to individual ELMs must be kept small to protect the diverter target from excess ablation. We report on discharges in DIII-D with electron densities as high as 1.45 times the Greenwald density, n(sub GW)(10(sup 20)m(sup -3))=I(sub p)(MA)/((pi)(sup 2)(m)), with good confinement, H(sub ITER89P)=1.9, and ELMs with energy amplitude small enough to protect the divertor. These results were achieved at low triangularity single-null divertor, (delta)(approx)0.0 with

a plasma current of 1.2 MA, q(sub 95) (approx) 3-4, and moderate neutral beam heating power of 2-4 MW. The density was controlled by moderate gas puffing and private flux pumping. A typical discharge is shown in Fig. 1 where upon gas puffing the pedestal density, n(sub e,epd), quickly rises to (approx)0.8 x n(sub GW). The confinement initially drops with the gas puff, on a longer timescale the central density rises, peaking the profile and increasing the confinement until an MHD instability terminates the high density and high confinement phase of the discharge. In this report we describe in detail edge pedestal changes and its effect on confinement as the density is increased. We then describe peaking of the density profile that offsets degradation of the pedestal at high density and restores good confinement. Finally we describe the small benign ELMs that result at these high densities.
NTIS
*Energy Dissipation; Magnetohydrodynamic Stability; Plasma Heating; Tokamak Devices; Electron Density (Concentration); Gases*

**20020016168** General Atomics Co., San Diego, CA USA
**Automated Calculation of DIII-D Neutral Beam Availability**
Phillips, J. C.; Hong, R. M.; Scoville, B. G.; Nov. 01, 1999; 7p; In English
Report No.(s): DE2001-766691; GA-A23286; No Copyright; Avail: Department of Energy Information Bridge
The neutral beam systems for the DIII-D tokamak are an extremely reliable source of auxiliary plasma heating, capable of supplying up to 20 MW of injected power, from eight separate beam sources into each tokamak discharge. The high availability of these systems for tokamak operations is sustained by careful monitoring of performance and following up on failures. One of the metrics for this performance is the requested injected power profile as compared to the power profile delivered for a particular pulse. Calculating this was a relatively straightforward task, however innovations such as the ability to modulate the beams and more recently the ability to substitute an idle beam for one which has failed during a plasma discharge, have made the task very complex. For example, with this latest advance it is possible for one or more beams to have failed, yet the delivered power profile may appear perfect. Availability used to be manually calculated. This paper presents the methods and algorithms used to produce a system which performs the calculations based on information concerning the neutral beam and plasma current waveforms, along with post-discharge information from the Plasma Control System, which has the ability to issue commands for beams in real time. Plots representing both the requested and actual power profiles, along with statistics, are automatically displayed and updated each shot, on a web-based interface viewable both at DIII-D and by our remote collaborators using no-cost software.
NTIS
*Algorithms; Neutral Beams; Plasma Control; Tokamak Devices; Automatic Control; Plasma Currents*

**20020016169** General Atomics Co., San Diego, CA USA
**Upgrade of the DIII-D GHz ECH System to 6 MW**
Cary, W. P.; Callis, R. W.; Lohr, J. M.; Ponce, D.; Legg, R. A.; Nov. 01, 1999; 7p; In English
Report No.(s): DE2001-766687; GA-A23258; No Copyright; Avail: Department of Energy Information Bridge
ECH power has proven capabilities to both heat and drive current in energetic plasmas. Recent developments in high power sources have made the use of these capabilities in energetic plasmas feasible. For the second phase of ECH power on DIII-D, there will be three 1 MW sources added to the existing 3 MW for a total generated power of 6 MW. The upgrade is based on the use of single disc CVD (chemical vapor deposition) diamond windows on 1 MW gyrotrons developed by CPI. AU gyrotrons are connected to the tokamak by low-loss-windowless evacuated transmission lines using circular corrugated waveguide for propagation in the HE(sub 11) mode. Each waveguide system incorporates a two-mirror launcher which can steer the rf beam poloidally from the center to the outer edge of the plasma and toroidally for either co- or counter-current drive. The total system overview and integration with existing systems will be discussed along with the new aspects of the upgrade from building modifications to the new launchers. Much of the upgrade is comprised of existing designs, which will need only slight modifications, while some components have required new designs because of longer pulse lengths.
NTIS
*Corrugated Waveguides; Cyclotron Resonance Devices; Plasmas (Physics); Tokamak Devices*

**20020016170** General Atomics Co., San Diego, CA USA
**MHD Instabilities Occurring Near/AT the Transport Barrier, Including Loss of Confinement in H-Modes**
Lao, L. L.; Sep. 01, 1999; 21p; In English
Report No.(s): DE2001-766652; GA-A23255; No Copyright; Avail: Department of Energy Information Bridge
In configurations with transport barriers the improved edge and core confinement leads to large pressure gradient and large edge bootstrap current density which often drive magnetohydrodynamic (MHD) instabilities terminating the discharge or

reducing the discharge performance. The edge and the core transport barriers deteriorate or are completely lost. In this presentation, recent experimental and theoretical developments concerning MHD instabilities occurring near/at the edge and the core transport barriers are summarized emphasizing the dominant instabilities and the comparison with theory.
NTIS
*Magnetohydrodynamic Stability; Plasma Control; Current Density; Electrostatics*

**20020016171** General Atomics Co., San Diego, CA USA
**Design and Analyses of Transmission Lines for the 110 GHzECH Upgrade to 6 MW for DIII-D**
Grunloh, H. J.; Baxi, C. B.; Chin, E.; Condon, M.; Doane, J. L.; Nov. 01, 1999; 7p; In English
Report No.(s): DE2001-766646; GA-A23288; No Copyright; Avail: Department of Energy Information Bridge
During the summer of 1999 the installation of three new Electron Cyclotron Heating (ECH) transmission lines began as part of the 110 GHz ECH Upgrade to 6 MW project for DIII-D. An important step in the development of the transmission line design was the selection of the waveguide size. to make this selection, analyses were conducted to characterize the thermal and radio frequency (rf) loss performance of the key corrugated waveguide components under 1 MW, long pulse (10 s, 1% duty cycle) operation. Other factors that were analyzed included vacuum conductance and pumping speed, ease of installation, space considerations, and overall cost. The two candidate transmission line sizes were 2.50 in. and 1.25 in. id. An overview of the design and layout of the proposed transmission lines for the DIII-D ECH upgrade project is presented. Details and results are given for the vacuum conductance analysis of the overall transmission line, the rf loss analyses and tests on corrugated waveguide and miter bends, and the thermal analyses of the mirrors in the corrugated waveguide switch and the power monitor miter bend. Finally, a discussion is presented which weighs the results of these analyses with the experience gained through the installation and operation of the existing three 1 MW ECH systems at DIII-D and concludes with the selection of 1.25 in. i.d. waveguide and components for the upgrade project.
NTIS
*Corrugated Waveguides; Electron Cyclotron Heating; Transmission Lines; Design Analysis; Resistance*

**20020016242** General Atomics Co., San Diego, CA USA
**Iefit - an interactive approach to high temperature fusion plasma magnetic equilibrium fitting**
Peng, Q.; Schachter, J.; Schissel, D. P.; Lao, L. L.; Jun. 01, 1999; 7p; In English
Report No.(s): DE2001-767041; GA-A23153; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
An interactive IDL based wrapper, IEFIT, has been created for the magnetic equilibrium reconstruction code EFIT written in FORTRAN. It allows high temperature fusion physicists to rapidly optimize a plasma equilibrium reconstruction by eliminating the unnecessarily repeated initialization in the conventional approach along with the immediate display of the fitting results of each input variation. It uses a new IDL based graphics package, GaPlotObj, developed in cooperation with Fanning Software Consulting, that provides a unified interface with great flexibility in presenting and analyzing scientific data. The overall interactivity reduces the process to minutes from the usual hours.
NTIS
*Plasma Equilibrium; High Temperature Plasmas*

**20020016243** General Atomics Co., San Diego, CA USA
**Demonstration of the ITER Power Exhaust Solution Using the Puff; Pump Technique on DIII-D**
Wade, M. R.; West, W. P.; Hill, D. N.; Allen, S. L.; Boedo, J. A.; Jul. 01, 1999; 7p; In English; 26th European Physical Society Conference on Controlled Fusion and Plasma Physics, 14-18 June 1999, Maastricht, Netherlands
Contract(s)/Grant(s): AC03-99ER54463; AC05-96OR22464; AC03-94AL85000; W-7405-ENG-48; FG03-95ER54294
Report No.(s): DE2001-766940; GA-A23171; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
In future, high power density fusion devices, the need to prevent excessive local deposition of the plasma energy efflux on the first-wall surfaces is a critical design consideration in order to maintain the integrity of such surfaces. This requirement must be met without significant impact on plasma purity or overall plasma confinement.
NTIS
*Fusion Reactors; Plasma Control; Plasma Heating; Design Analysis; Exhaust Emission; Tokamak Devices*

**20020016249** Princeton Univ., Plasma Physics Lab., NJ USA
**Long Term Tritium Trapping in TFTR and JET**
Skinner, C. H.; Gentile, C. A.; Young, K. M.; Coad, J. P.; Hogan, J. T.; Jul. 24, 2001; 8p; In English
Report No.(s): DE2001-787787; PPPL-3594; No Copyright; Avail: Department of Energy Information Bridge

Tritium retention in TFTR (Tokamak Fusion Test Reactor) and JET (Joint European Torus) shows striking similarities and contrasts. In TFTR, 5 g of tritium were injected into circular plasmas over a 3.5 year period, mostly by neutral-beam injection. In JET, 35 g were injected into divertor plasmas over a 6 month campaign, mostly by gas puffing. In TFTR, the bumper limiter provided a large source of eroded carbon and a major part of tritium was co-deposited on the limiter and vessel wall. Only a small area of the co-deposit flaked off. In JET, the wall is a net erosion area, and co-deposition occurs principally in shadowed parts of the inner divertor, with heavy flaking. In both machines, the initial tritium retention, after a change from deuterium (D) to tritium (T) gas puffing, is high and is due to isotope exchange with deuterium on plasma-facing surfaces (dynamic inventory). The contribution of co-deposition is lower but cumulative, and is revealed by including periods of D fueling that reversed the T/D isotope exchange.Ion beam analysis of flakes from TFTR showed an atomic D/C ratio of 0.13 on the plasma facing surface, 0.25 on the back surface and 0.11 in the bulk. Data from a JET divertor tile showed a larger D/C ratio with 46% C, 30% D, 20% H and 4% O. Deuterium, tritium, and berylium profiles have been measured and show a thin less than 50 micron co-deposited layer. Flakes retrieved from the JET vacuum vessel exhibited a high tritium release rate of 2e10 Bq/month/g. BBQ modeling of the effect of lithium on retention in TFTR showed overlapping lithium and tritium implantation and a 1.3x increase in local T retention.
NTIS
*Retention; Tritium; Fusion Reactors; Nuclear Research and Test Reactors*

**20020016253** Princeton Univ., Plasma Physics Lab., NJ USA
**Stochastic Ion Heating at the Magnetopause due to Kinetic Alfven Waves**
Johnson, J. R.; Cheng, C. Z.; Aug. 10, 2001; 11p; In English
Report No.(s): DE2001-787902; PPPL-3596; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The magnetopause and boundary layer are typically characterized by large amplitude transverse wave activity with frequency below the ion cyclotron frequency. The signatures of the transverse waves suggest that they are kinetic Alfven waves with wavelength on the order of the ion gyroradius.We investigate ion motion in the presence of large amplitude kinetic Alfven waves with wavelength the order of rho(subscript "i") and demonstrate that for sufficiently large wave amplitude (delta B(subscript "perpendicular& quot;)/B(subscript "0") > 0.05) the particle orbits become stochastic. As a result, low energy particles in the core of the ion distribution can migrate to higher energy through the stochastic sea leading to an increase in T(subscript "perpendicular") and a broadening of the distribution. This process can explain transverse ion energization and formation of conics which have been observed in the low-latitude boundary layer.
NTIS
*Magnetopause; Stochastic Processes; Ion Motion; Heating; Transverse Waves; Ion Cyclotron Radiation*

**20020016255** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**Plasma density from Cerenkov radiation, betatron oscillations, and beam steering in a plasma wakefield experiment at 30 GeV**
Catravas, P.; Chattopadhyay, S.; Esarey, E.; Leemans, W. P.; Assmann, R.; Jan. 01, 2001; 9p; In English
Report No.(s): DE20-01787115; LOL NOTE-077; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Measurements of radiation near the 670.8 nm atomic spectral line of Lithium as a 30 GeV electron beam propagates through a long, high density heat pipe oven (approx. 1 meter, neutral density approx. 10 15/cc) have been performed. Practical considerations in the use of Cerenkox radiation as an automatically synchronized diagnostic of the plasma source properties are investigated. Parametric scans of the Cerenkov spatial profile (temperature, pressure, wavelength and laser/beam delay) are presented and the source neutral and plasma density are estimated from the measurements. Large increases in the number of intercepted photons are noted in the presence of plasma near strong spectral lines which depend on laser/e beam timing and steering.
NTIS
*Cerenkov Radiation; Plasma Density; Betatrons; Oscillations; Beam Steering; Plasmas (Physics)*

**20020016286** Princeton Univ., Plasma Physics Lab., NJ USA
**Kinetic Profiles in NSTX Plasmas**
Bell, R. E.; LeBlanc, B. P.; Bourdelle, C.; Ernst, D. R.; Fredrickson, E. D.; Jul. 10, 2001; 8p; In English
Report No.(s): DE2001-787778; PPPL-3591; No Copyright; Avail: Department of Energy Information Bridge
The National Spherical Torus Experiment (NSTX) is a low aspect ratio (R/a approximately 1.3) device with auxiliary heating from neutral-beam injection (NBI) and high-harmonic fast-wave heating (HHFW). Typical NSTX parameters are R(subscript '') = 85 cm, a = 67 cm, I(subscript '') = 0.7-1.4 MA, B(subscript '') = 0.25-0.45 T. Three co-directed deuterium neutral-beam sources have injected P(subscript '') less than or equal to 4.7 MW. HHFW plasmas typically have delivered P(subscript '') less than or

equal to 3 MW. Important to the understanding of NSTX confinement are the new kinetic profile diagnostics: a multi-pulse Thomson scattering system (MPTS) and a charge-exchange recombination spectroscopy (CHERS) system. The MPTS diagnostic currently measures electron density and temperature profiles at 30 Hz at ten spatial locations. The CHERS system has recently become available to measure carbon ion temperature and toroidal flow at 17 radial positions spanning the outer half of the minor radius with 20 msec time resolution during NBI. Experiments conducted during the last year have produced a wide range of kinetic profiles in NSTX. Some interesting examples are presented below.
NTIS
*Kinetics; Plasmas (Physics); Beam Injection; Charge Transfer; Deuterium; Temperature Profiles*

**20020016298** General Atomics Co., San Diego, CA USA
**Characterization and Modification of Edge-Driven Instabilities in the DIII-D Tokamak**
Ferron, J. R.; Lao, L. L.; Osborne, T. H.; Strait, E. J.; Turnbull, A. D.; Jul. 01, 1999; 7p; In English; 26th European Physical Society Conference on Controlled Fusion and Plasma Physics, 14-18 June 1999, Maastricht, Netherlands
Contract(s)/Grant(s): AC03-99ER54463; AC05-96OR22464; FG03-86ER53225; FG03-94ER54271; W-7405-ENG-48
Report No.(s): DE2001-766941; GA-A23156; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The character of edge localized modes (ELMs) and the height of the edge pressure pedestal in DIII-D tokamak H-mode discharges have been modified by varying the discharge shape (triangularity and squareness) and the safety factor, increasing the edge radiation, and injecting deuterium pellets. Changes in the ELM frequency and amplitude, and the magnitude of the edge pressure gradient, and changes in the calculated extent of the region of access to the ballooning mode second stability regime are observed.
NTIS
*Magnetohydrodynamic Stability; Tokamak Devices*

**20020016299** General Atomics Co., San Diego, CA USA
**Comparison of Plasma Performance Between Single-Null and Double-Null Configurations During Elming H-Mode**
Petrie, T. W.; Fenstermacher, M. E.; Allen, S. L.; Carlstrom, T. N.; Gohil, P.; Jul. 01, 1999; 7p; In English; 26th European Physical Society Conference on Controlled Fusion and Plasma Physics, 14-18 June 1999, Maastricht, Netherlands
Contract(s)/Grant(s): AC03-99ER54463; AC04-94AL85000; W-7405-ENG-48; FG03-86ER53225
Report No.(s): DE2001-766942; GA-A23155; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Tokamak plasma performance generally improves with increased shaping of the plasma cross section, such as higher elongation and higher triangularity. The stronger shaping, especially higher triangularity, leads to changes in the magnetic topology of the divertor. Because there are engineering and divertor physics issues associated with changes in the details of the divertor flux geometry, especially as the configuration transitions from a single-null (SN) divertor to a marginally balanced double-null (DN) divertor, we have undertaken a systematic evaluation of the plasma characteristics as the magnetic geometry is varied.
NTIS
*Plasmas (Physics); Tokamak Devices; Plasma Control*

**20020016318** Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA
**Development and Validation of a Multi-Species Reacting Flow Model for the Plasma Jet Generated by an ETC Igniter**
Nusca, Michael J., Army Research Lab., USA; McQuaid, Michael J., Army Research Lab., USA; Anderson, William R., Army Research Lab., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 305-320; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche
The Army Research Laboratory (ARL) is investigating the Electrothermal-Chemical (ETC) gun concept. As part of this program, the ARL has undertaken a comprehensive study of the interaction of the plasma efflux from a ETC igniter with solid propellant grains. The goal of this work is to elucidate the physical, mechanical, and chemical mechanisms that underlie the observed ballistic effects in ETC guns that lead to performance gains. The present paper describes the first phase of the modeling effort in support of this plasma-propellant interaction project. A time-accurate computational fluid dynamics (CFD) code is used that includes high-temperature thermodynamics, variable specific heats and transport properties (viscosity and thermal conductivity), and finite-rate (nonequilibrium) chemical kinetics. Validation of this code utilizes a series of experiments with an ETC igniter fired into open-air, generating an unsteady flow field in which an instrumented plate is placed. Computer simulations

reveal important gas dynamic and chemical details of the plasma jet as it mixes with air and interacts with the plate, representing a unique model of the ETC plasmas.
Author
*Computational Fluid Dynamics; Igniters; Reacting Flow; Solid Propellants; Plasma Jets; Gun Propellants; Ballistics; Thermodynamics*

**20020016455** Princeton Univ., Plasma Physics Lab., NJ USA
**Comparison of Theory with Rotation Measurements in JET ICRH Plasmas**
Budny, R. V.; Chang, C. S.; Giroud, C.; Goldston, R. J.; McCune, D.; Jun. 27, 2001; 8p; In English
Report No.(s): DE2001-787685; PPPL-3585; No Copyright; Avail: Department of Energy Information Bridge

Plasma rotation appears to improve plasma performance by increasing the E x B flow shearing rate, thus decreasing radial correlations in the microturbulence. Also, plasma rotation can increase the stability to resistive magnetohydrodynamic modes. In the Joint European Torus (JET), toroidal rotation rates omega(sub tor) with high Mach numbers are generally measured in NBI-heated plasmas (since the neutral beams aim in the co-plasma current direction). They are considerably lower with only ICRH (and Ohmic) heating, but still surprisingly large considering that ICRH appears to inject relatively small amounts of angular momentum. Either the applied torques are larger than naively expected, or the anomalous transport of angular momentum is smaller than expected. Since ICRH is one of the main candidates for heating next-step tokamaks, and for creating burning plasmas in future tokamak reactors, this paper attempts to understand ICRH-induced plasma rotation.
NTIS
*Joint European Torus; Rotation; Turbulence; Plasma Waves; Plasmas (Physics)*

**20020016456** Princeton Univ., Plasma Physics Lab., NJ USA
**Unusual Low-frequency Magnetic Perturbations in TFTR**
Takahashi, H.; Fredrickson, E. D.; Chance, M. S.; Feb. 12, 2001; 84p; In English
Report No.(s): DE2001-787684; PPPL-3584; No Copyright; Avail: Department of Energy Information Bridge

Low-frequency magnetic perturbations (is less than = 30 kHz) observed in the Tokamak Fusion Test Reactor (TFTR) tokamak do not always conform to expectations from magnetohydrodynamic (MHD) modes. The discrepancy between observations and expectations arises from the existence of three classes of magnetic perturbations in TFTR: (1) Edge Originated Magnetic Perturbations (EOMP's); (2) Kink-Like Modes (KLM's); and (3) Tearing Modes (TM's). The EOMP class has unusual magnetic phenomenon including up/down asymmetry in poloidal intensity variation that MHD modes alone cannot generate. The contributions of MHD modes in plasma edge regions are too small to explain the magnitude of observed EOMP perturbations. At least two-thirds, possibly nearly all, of magnetic perturbations in a typical EOMP originate from sources other than MHD modes. An EOMP has a unity toroidal harmonic number and a poloidal harmonic number close to a discharge's edge q-value. It produces little temperature fluctuations, except possibly in edge regions. The KLM class produces temperature fluctuations, mostly confined within the q=1 surface with an ideal-mode-like structure, but generates little external magnetic perturbations. The TM class conforms generally to expectations from MHD modes. We propose that current flowing in the scrape-off-layer plasma is a possible origin of EOMP's.
NTIS
*Fusion Reactors; Magnetohydrodynamics; Perturbation; Plasmas (Physics); Tokamak Devices*

**20020016457** Princeton Univ., Plasma Physics Lab., NJ USA
**Measurement of Lower-hybrid Drift Turbulence in a Reconnecting Current Sheet**
Carter, T. A.; Ji, H.; Trintchouk, F.; Yamada, M.; Kulsrud, R. M.; Jun. 20, 2001; 16p; In English
Report No.(s): DE2001-787682; PPPL-3583; No Copyright; Avail: Department of Energy Information Bridge

We present a detailed study of fluctuations in a laboratory current sheet undergoing magnetic reconnection. The measurements reveal the presence of lower-hybrid-frequency range fluctuations on the edge of current sheets produced in the Magnetic Reconnection Experiment (MRX). The measured fluctuation characteristics are consistent with theoretical predictions for the lower-hybrid drift instability (LHDI). Our observations suggest that the LHDI does not provide any significant turbulent resistivity in MRX current sheets.
NTIS
*Current Sheets; Frequency Ranges; Magnetohydrodynamic Stability; Turbulence*

**20020016458** Princeton Univ., Plasma Physics Lab., NJ USA

**Physics Regimes in the Fusion Ignition Research Experiment (FIRE)**

Meade, D. M.; Jardin, S. C.; Kessel, C. E.; Ulrickson, M. A.; Schultz, J. H.; Jun. 19, 2001; 8p; In English

Report No.(s): DE2001-787681; PPPL-3582; No Copyright; Avail: Department of Energy Information Bridge

Burning plasma science is recognized widely as the next frontier in fusion research. The Fusion Ignition Research Experiment (FIRE) is a design study of a next-step burning plasma experiment with the goal of developing a concept for an experimental facility to explore and understand the strong nonlinear coupling among confinement, magnetohydrodynamic (MHD) self-heating, stability, edge physics, and wave-particle interactions that is fundamental to fusion plasma behavior. This will require plasmas dominated by alpha heating (Q > 5) that are sustained for a duration comparable to characteristic plasma timescales (> 10) tau(sub He), approximately 4 tau(He), approximately 2 tau(sub skin). The work reported here has been undertaken with the objective of finding the minimum size (cost) device to achieve these physics goals.

NTIS

*Ignition; Magnetohydrodynamics; Plasmas (Physics); Fusion Reactors*

**20020016460** Princeton Univ., Plasma Physics Lab., NJ USA

**Effects of Radial Electric Fields on ICRF Waves**

Phillips, C. K.; Hosea, J. C.; Ono, M.; Wilson, J. R.; Jun. 18, 2001; 8p; In English

Report No.(s): DE2001-787679; PPPL-3580; No Copyright; Avail: Department of Energy Information Bridge

Equilibrium considerations infer that large localized radial electric fields are associated with internal transport barrier structures in tokamaks and other toroidal magnetic confinement configurations. In this paper, the effects of an equilibrium electric field on fast magnetosonic wave propagation are considered in the context of a cold plasma model.

NTIS

*Cold Plasmas; Magnetoacoustic Waves; Plasma Heating; Wave Propagation*

**20020016971** NASA Marshall Space Flight Center, Huntsville, AL USA

**Robe Development for Electrical Conductivity Analysis in an Electron Gun Produced Helium Plasma**

Bragg-Sitton, Shannon M., NASA Marshall Space Flight Center, USA; Bitteker, Leo, NASA Marshall Space Flight Center, USA; [2002]; 6p; In English; 33rd AIAA Plasmadynamics and Lasers Conference, 20-23 May 2002, Maui, HI, Maui, HI, USA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The use of magnetohydrodynamic (MHD) power conversion systems, potentially coupled with a fission power source, is currently being investigated as a driver for an advanced propulsion system, such as a plasma thruster. The efficiency of a MHD generator is strongly dependent on the electrical conductivity of the fluid that passes through the generator; power density increases as fluid conductivity increases. Although traditional MHD flows depend on thermal ionization to enhance the electrical conductivity, ionization due to nuclear interactions may achieve a comparable or improved conductivity enhancement while avoiding many of the limitations inherent to thermal ionization. Calculations suggest that nuclear-enhanced electrical conductivity increases as the neutron flux increases; conductivity of pure He-3 greater than 10 mho/m may be achievable if exposed to a flux greater than 10(exp 12) neutrons/cm2/s.) However, this remains to be demonstrated experimentally. An experimental facility has been constructed at the Propulsion Research Center at the NASA Marshall Space Flight Center, using helium as the test fluid. High energy electrons will be used to simulate the effects of neutron-induced ionization of helium gas to produce a plasma. These experiments will be focused on diagnosis of the plasma in a virtually static system; results will be applied to future tests with a MHD system. Initial experiments will utilize a 50 keV electron gun that can operate at up to a current of 200 micro A. Spreading the electron beam over a four inch diameter window results in an electron flux of 1.5x 10(exp 13) e/sq cm/s. The equivalent neutron flux that would produce the same ionization fraction in helium is 1x10(exp 12) n/sq cm/s. Experiments will simulate the neutron generated plasma modeled by Bitteker, which takes into account the products of thermal neutron absorption in He-3, and includes various ion species in estimating the conductivity of the resulting plasma. Several different probes will be designed and implemented to verify the plasma kinetics model. System parameters and estimated operating ranges are summarized. The predicted ionization fraction, electron density, and conductivity levels are provided in for an equivalent neutron flux of 1x10(exp 12) n/cm2/s. Understanding the complex plasma kinetics throughout a MHD channel is necessary to design an optimal power conversion system for space propulsion applications. The proposed experiments seek to fully characterize the helium plasma and to determine the reliability of each measurement technique, such that they may be applied to more advanced MHD studies. The expected value of each plasma parameter determined from theoretical models will be verified

experimentally by several independent techniques to determine the most reliable method of obtaining each parameter. The results of these experiments will be presented in the final paper.
Author
*Electrical Resistivity; Electron Guns; Helium Isotopes; Helium Plasma; Magnetohydrodynamics; Thermal Neutrons; Mathematical Models*

**20020017268** Princeton Univ., Plasma Physics Lab., NJ USA
**Expansion Rate Measurements at Moderate Pressure of Nonneutral Electron Plasmas in the Electron Diffusion Gauge (EDG) Experiment**
Morrison, K. A.; Davidson, R. C.; Paul, S. F.; Belli, E. A.; and Chao, E. H.; May 18, 2001; 18p; In English
Report No.(s): DE2001-784553; PPPL-3567; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Measurements of the expansion rate of pure-electron plasmas have been performed on the Electron Diffusion Gauge (EDG) device at background helium gas pressures in the 5 x 10(exp -8) Torr to 1 x 10(exp -5) Torr range, where plasma expansion due to electron-neutral collisions dominates over plasma expansion due to trap asymmetries. It is found that the expansion rate, defined as the time rate of change of the particles' mean-square radius, scales approximately linearly with pressure and inversely as the square of the magnetic field strength in this regime, in agreement with classical predictions.
NTIS
*Electron Diffusion; Electron Plasma; Electron Scattering*

**20020017479** Princeton Univ., Plasma Physics Lab., NJ USA
**Nonlinear Gyroviscous Force in a Collisionless Plasma**
Belova, E. V.; May 23, 2001; 31p; In English
Report No.(s): DE2001-784555; PPPL-3569; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Nonlinear gyroviscous forces in a collisionless plasma with temperature variations are calculated from the gyrofluid moments of the gyrokinetic Vlasov equation. The low-frequency gyrokinetic ordering and electrostatic perturbations are assumed, and an additional finite Larmor radius (FLR) expansion is performed. This approach leads naturally to an expression for the gyroviscous force in terms of the gyrocenter distribution function, thus including all resonant effects, and represents a systematic FLR expansion in a general form (no assumption of any closure is made). The expression for the gyroviscous force is also calculated in terms of the particle-fluid moments by making the transformation from the gyrocenter to particle coordinates. The calculated expression represents a modification of the Braginskii gyroviscosity for a collisionless plasma with nonuniform temperature. It is compared with previous calculations based on the traditional fluid approach. As a byproduct of the gyroviscosity calculations, we derive a set of nonlinear reduced gyrofluid (and a corresponding set of particle-fluid) moment equations with FLR corrections, which exhibit a generalized form of the "gyroviscous cancellation."
NTIS
*Vlasov Equations; Collisionless Plasmas*

**20020017526** Princeton Univ., Plasma Physics Lab., NJ USA
**Mode Conversion Heating Scenarios for the National Compact Stellarator Experiment**
Majeski, R.; Wilson, J. R.; Zarnstorff, M.; May 18, 2001; 8p; In English
Report No.(s): DE2001-784552; PPPL-3566; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Radio-frequency heating scenarios for the National Compact Stellarator eXperiment (NCSX) are considered. The focus here is on mode conversion from the fast to the slow ion Bernstein wave as either an electron or "bulk" ion heating technique, using a high-field side launch to directly access the ion-ion hybrid layer. Modeling for the planned parameters of NCSX (R(sub ave) approximately)1.4 m, a(sub ave) approximately 0.4 m, B(sub T)(0) approximately 1.2-2 T, n(sub e)(0) approximately 2-5 x 10(exp 19) m(sup -3), T(sub e)(0) approximately T(sub i)(0) approximately 1-2 keV) for mode conversion in D-H and D-3He plasmas is presented. Possible types of high-field side antennas are also briefly discussed.
NTIS
*Mode Transformers; Stellarators; Radio Frequency Heating*

**20020017527** Princeton Univ., Plasma Physics Lab., NJ USA
**Investigation of Ion Absorption of the High Harmonic Fast Wave in NSTX using HPRT**
Rosenberg, A.; Menard, J. E.; LeBlanc, B. P.; May 18, 2001; 8p; In English
Report No.(s): DE2001-784551; PPPL-3565; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Understanding high harmonic fast wave (HHFW) power absorption by ions in a spherical torus (ST) is of critical importance to assessing the wave's viability as a means of heating and especially driving current. In this work, the HPRT code is used to calculate absorption for helium and deuterium, with and without minority hydrogen in National Spherical Torus Experiment (NSTX) plasmas using experimental EFIT code equilibria and kinetic profiles. HPRT is a two-dimensional ray-tracing code which uses the full hot plasma dielectric to compute the perpendicular wave number along the hot electron and cold ion plasma ray path. Ion and electron absorption dependence on antenna phasing, ion temperature, beta (sub t), and minority temperature and concentration is analyzed. These results form the basis for comparisons with other codes, such as CURRAY, METS, TORIC, and AORSA.
NTIS
*Ions; Toruses; Deuterium; Helium; Spherical Plasmas*

**20020017528** Princeton Univ., Plasma Physics Lab., NJ USA
**Profile Modifications Resulting from Early High-harmonic Fast Wave heating in NSTX**
Mendard, J. E.; LeBlanc, W. J. R.; Sabbagh, S. A.; Stutman, D.; Swain, D. W.; May 18, 2001; 8p; In English
Report No.(s): DE2001-784550; PPPL-3564; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Experiments have been performed in the National Spherical Torus Experiment (NSTX) to inject high harmonic fast wave (HHFW) power early during the plasma current ramp-up in an attempt to reduce the current penetration rate to raise the central safety factor during the flattop phase of the discharge. To date, up to 2 MW of HHFW power has been coupled to deuterium plasmas as early as t = 50 ms using the slowest interstrap phasing of k approximately equals 14 m(sup -1) (nf = 24). Antenna-plasma gap scans have been performed and find that for small gaps (5-8 cm), electron heating is observed with relatively small density rises and modest reductions in current penetration rate. For somewhat larger gaps (10-12 cm), weak electron heating is observed but with a spontaneous density rise at the plasma edge similar to that observed in NSTX H-modes. In the larger gap configuration, EFIT code reconstructions (without MSE (motional Stark effect)) find that resistive flux consumption is reduced as much as 30%, the internal inductance is maintained below 0.6 at 1 MA into the flattop, q(0) is increased significantly, and the MHD stability character of the discharges is strongly modified.
NTIS
*Toruses; Safety Factors; Plasma Heating; Plasma Currents*

**20020017529** Princeton Univ., Plasma Physics Lab., NJ USA
**Characteristics of the First H-mode Discharges in NSTX**
Maingi, R.; Bell, M. G.; Bell, R. E.; Bush, C. E.; Fredrickson, E. D.; May 10, 2001; 18p; In English
Report No.(s): DE2001-784549; PPPL-3563; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We report observations of the first low-to-high (L-H) confinement mode transitions in the National Spherical Torus Experiment (NSTX). The H-mode energy confinement time increased over reference L-mode discharges transiently by 100-300%, as high as approximately 150 ms. This confinement time is approximately 1.8-2.3 times higher than predicted by a multi-machine ELM-free H-mode scaling. This achievement extends the H-mode window of fusion devices down to a record low aspect ratio (R/a) approximately 1.3, challenging both confinement and L-H power thresholds scalings based on conventional aspect ratio tokamaks.
NTIS
*Plasma Control; Toruses*

**20020017534** Princeton Univ., Plasma Physics Lab., NJ USA
**Electron Bernstein Wave Research on CDX-U and NSTX**
Taylor, G.; Efthimion, P. C.; Jones, B.; Hosea, J. C.; Kaita, R.; May 18, 2001; 12p; In English
Report No.(s): DE2001-784554; PPPL-3568; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Mode-converted electron Bernstein waves (EBWs) potentially allow the measurement of local electron temperature (Te) and the implementation of local heating and current drive in spherical torus (ST) devices, which are not directly accessible to low harmonic electron cyclotron waves. This paper reports on the measurement of X-mode radiation mode-converted from EBWs observed normal to the magnetic field on the midplane of the Current Drive Experiment-Upgrade (CDX-U) and the National Spherical Torus Experiment (NSTX) spherical torus plasmas. The radiation temperature of the EBW emission was compared to Te measured by Thomson scattering and Langmuir probes. EBW mode-conversion efficiencies of over 20% were measured on both CDX-U and NSTX. Sudden increases of mode-conversion efficiency, of over a factor of three, were observed at high-confinement-mode transitions on NSTX, when the measured edge density profile steepened. The EBW mode-conversion efficiency was found to depend on the density gradient at the mode-conversion layer in the plasma scrape-off, consistent with

theoretical predictions. The EBW emission source was determined by a perturbation technique to be localized at the electron cyclotron resonance layer and was successfully used for radial transport studies. Recently, a new in-vessel antenna and Langmuir probe array were installed on CDX-U to better characterize and enhance the EBW mode-conversion process. The probe incorporates a local adjustable limiter to control and maximize the mode-conversion efficiency in front of the antenna by modifying the density profile in the plasma scrape-off where fundamental EBW mode conversion occurs. Initial results show that the mode-conversion efficiency can be increased to approximately 100% when the local limiter is inserted near the mode-conversion layer. Plans for future EBW research, including EBW heating and current-drive studies, are discussed.
NTIS
*Magnetic Fields; Energy Conversion Efficiency; Electron Cyclotron Resonance*

**20020018821** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Strong IMF By-Related Plasma Convection in the Ionosphere and Cusp Field-Aligned Currents Under Northward IMF Conditions**
Le, G., NASA Goddard Space Flight Center, USA; Lu, G., National Center for Atmospheric Research, USA; Strangeway, R. J., California Univ., USA; Pfaff, R. F., Jr., NASA Goddard Space Flight Center, USA; [2001]; 40p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We present in this paper an investigation of IMF-By related plasma convection and cusp field-aligned currents using FAST data and AMIE model during a prolonged interval with large positive IMF by and northward Bz conditions (By/Bz much greater than 1). Using the FAST single trajectory observations to validate the global convection patterns at key times and key locations, we have demonstrated that the AMIE procedure provides a reasonably good description of plasma circulations in the ionosphere during this interval. Our results show that the plasma convection in the ionosphere is consistent with the anti-parallel merging model. When the IMF has a strongly positive by component under northward conditions, we find that the global plasma convection forms two cells oriented nearly along the Sun-earth line in the ionosphere. In the northern hemisphere, the dayside cell has clockwise convection mainly circulating within the polar cap on open field lines. A second cell with counterclockwise convection is located in the nightside circulating across the polar cap boundary, The observed two-cell convection pattern appears to be driven by the reconnection along the anti-parallel merging lines poleward of the cusp extending toward the dusk side when IMF By/Bz much greater than 1. The magnetic tension force on the newly reconnected field lines drives the plasma to move from dusk to dawn in the polar cusp region near the polar cap boundary. The field-aligned currents in the cusp region flow downward into the ionosphere. The return field-aligned currents extend into the polar cap in the center of the dayside convection cell. The field-aligned currents are closed through the Peterson currents in the ionosphere, which flow poleward from the polar cap boundary along the electric field direction.
Author
*Circulation; Convection; Twilight Glow; Ionospheric Currents; Plasma Dynamics*

**20020018840** Stanford Linear Accelerator Center, CA USA
**Longitudinal Laser Shaping in Laser Wakefield Accelerators**
Chen, P.; Aug. 09, 2001; 5p; In English
Report No.(s): DE2001-787215; SLAC-PUB-8948; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We study the energetics of wake excitation during the laser-plasma interaction in application to laser wakefield accelerators. We find that both the wake amplitude and the accelerating efficiency (transformer ratio) can be maximized by properly shaping the longitudinal profile of the driving laser pulse. The corresponding family of laser pulse shapes is derived in the derived in the nonlinear regime of laser-plasma interaction. Such shapes provide theoretical upper limit on the magnitude of the wakefield and efficiency by allowing for uniform photon deceleration inside the laser pulse. We also construct realistic optimal pulse shapes that can be produced in finite-bandwidth laser systems.
NTIS
*Pulsed Lasers; Plasma Accelerators; Excitation; Laser Applications; Photons*

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## SOLID-STATE PHYSICS

*Includes condensed matter physics, crystallography, and superconductivity. For related information see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.*

**20020016106** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA
**Electrical Activation Studies of Ion Implanted Gallium Nitride**
Fellows, James A.; Nov. 20, 2001; 221p; In English; Original contains color images
Report No.(s): AD-A396548; AFIT/DS/ENP/02-2; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

A comprehensive and systematic electrical activation study of Si-implanted GaN was performed as a function of ion implantation dose, anneal temperature, and implantation temperature. Additionally, Mg-implanted GaN was also investigated. Temperature-dependent Hall effect measurements and photoluminescence (PL) spectra were used to characterize the samples. GaN wafers capped with AlN were implanted with Si ions at doses ranging from 1x10(exp 13) to 5x10(exp 15)/sq cm and annealed from 1050 to 1350 C. The optimum anneal temperature for samples implanted with the higher Si doses is around 1350 C, exhibiting nearly 100% electrical activation efficiency. Exceptional mobilities and carrier concentrations were obtained on all Si-implanted samples. PL spectra revealed nearly complete implantation damage recovery as well as the nature of the yellow luminescence plaguing nearly all Si-doped GaN. Additionally, GaN wafers were implanted with Mg and various coimplants and annealed from 1100 to 1350 C. All of the Mg-implanted and most of the Mg-coimplanted GaN samples became extremely resistive, and did not show definite p-type conductivity even after annealing at 1350 C, remaining highly resistive even at a sample temperature as high as 800 K. A dominant 2.36 eV green luminescence band observed in the PL spectra of all Mg-implanted samples is attributed to a Mg-related deep complex DAP transition. The inefficient electrical activation of Mg acceptors implanted into GaN is attributed to these Mg-related deep complexes.
DTIC
*Annealing; Gallium Nitrides; Ion Implantation; Electrical Properties*

**20020016147** Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
**Solid State Research** ***Quarterly Report, 1 Feb.-30 Apr. 2001***
Shaver, David C.; Nov. 30, 2001; 74p; In English; Original contains color images
Contract(s)/Grant(s): F19628-00-C-0002
Report No.(s): AD-A396796; ESC-TR-2001-042; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report covers in detail the research work of the Solid State Division at Lincoln Laboratory for the period 1 February through 30 April 2001. The topics covered are Quantum Electronics, Electro-optical Materials and Devices, Submicrometer Technology, Biosensor and Molecular Technologies, Advanced Imaging Technology, Analog Device Technology, and Advanced Silicon Technology.
DTIC
*Quantum Electronics; Bioinstrumentation; Electro-Optics; Solid State Physics*

**20020016180** National Renewable Energy Lab., Golden, CO USA
**Fundamental studies of the effect of crystal defects on CuInSe2/CdS heterojunction behavior** ***Final Report, 28 Jun. 1993 - 30 Jun. 1998***
Rockett, A.; Nov. 17, 1999; 80p; In English
Report No.(s): DE2001-750887; NREL/SR-590-25623; No Copyright; Avail: Department of Energy Information Bridge

This report describes the work performed by the University of Illinois at Urbana-Champaign. The following results were obtained under the work funded by this subcontract: (1) Point defects and electronic properties of CuIn(1-x)Ga(x))Se2: New record results for hole mobilities in CuIn(1-x)Ga(x)Se2 based on single crystals grown by Rockett's group; Demonstrated the role of Ga in determining hole concentrations; Showed that Ga does not affect the hole mobility in this material and why this is the case; Determined the diffusion coefficient for Ga in single-crystal CuIn(1-x)Ga(x)Se2; Demonstrated the structure and optoelectronic properties of the CuIn3Se5 ordered-defect phase of CuInSe2; Characterized the detailed effects of Na on CuIn(1-x)Ga(x)Se2 solar cells and on the fundamental properties of the material itself (reduces compensating donors in p-type materials); and In collaboration with groups at the Universities of Salford and Liverpool in the UK, studied the effect of ion implantation damage on CuIn(1-x)Ga(x))Se2 single-crystals. (2) Materials for and characterization of devices: Developed a novel contact metallurgy that improves adhesion to the underlying Mo back-contact in solar cells made with CuIn(1-x)Ga(x)Se2; (This material has also yielded substantial novel materials science behaviors, including grain rotation and growth prior to phase separation in a metastable binary alloy.) Characterized the electroluminescence as a function of temperature and Ga content in

CuIn(1-x)Ga(x)Se2 solar cells and showed that the radiative recombination pathways are not band-to-band as in normal semiconductors, but rather, proceed through defect states; and Working with a group at the University of Uppsala in Sweden, demonstrated novel aspects of the bonding and chemistry of dip-coated CdS heterojunction materials used as heterojunction partner materials in CuIn(1-x)Ga(x)Se2 solar cells.
NTIS
*Crystal Defects; Heterojunctions; Single Crystals; Electroluminescence; Copper Indium Selenides; Cadmium Sulfides*

**20020016197** California Univ., Berkeley, CA USA
**Pump probe spectroscopy of quasiparticle dynamics in cuprate superconductors**
Segre, G. P.; May 01, 2001; 79p; In English
Report No.(s): DE2001-787131; LBNL-47899; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Pump probe spectroscopy is used to examine the picosecond response of a BSCCO thin film, and two YBCO crystals in the near infrared. The role of pump fluence and temperature have been closely examined in an effort to clarify the mechanism by which the quasiparticles rejoin the condensate. BSCCO results suggest that the recombination behavior is consistent with the d-wave density of states in that quasiparticles appear to relax to the nodes immediately before they rejoin the condensate. The first substantial investigation of polarized pump probe response in detwinned YBCO crystals is also reported. Dramatic doping dependent anisotropies along the a and b axes are observed in time and temperature resolved studies. Among many results, we highlight the discovery of an anomalous temperature and time dependence of a- axis response in optimally doped YBCO. We also report on the first observation of the photoinduced response in a magnetic field. We find the amplitude of the response, and in some cases, the dynamics considerably changed with the application of a 6T field. Finally, we speculate on two of the many theoretical directions stimulated by our results. We find that the two-fluid model suggests a mechanism to explain how changes at very low energies are visible to a high-energy probe. Also discussed are basic recombination processes which may play a role in the observed decay.
NTIS
*Spectroscopy; Crystals; Superconductors (Materials); Measuring Instruments*

**20020016211** Sandia National Labs., Albuquerque, NM USA
**Evolution of Stress in ScD2/Cr Thin Films Fabricated by Evaporation and High Temperature Reaction**
Adams,; Brown,; Goeke,; Romero,; Silva,; Jun. 01, 2001; 43p; In English
Report No.(s): DE2001-783088; SAND2001-1629; No Copyright; Avail: Department of Energy Information Bridge
The stress of scandium dideuteride, ScD2, thin films is investigated during each stage of vacuum processing including metal deposition via evaporation, reaction, and cooldown. ScD2 films with thin Cr underlayers are fabricated on three different substrate materials: molybdenum-alumina cermet, single crystal sapphire, and quartz. In all experiments, the evaporated Cr and Sc metal is relatively stress-free. However, reaction of scandium metal with deuterium at elevated temperature to form a stoichiometric dideuteride phase leads to a large compressive in-plane film stress. Compression during hydriding results from an increased atomic density compared with the as-deposited metal film. After reaction with deuterium, samples are cooled to ambient temperature, and a tensile stress develops due to mismatched coefficients of thermal expansion (CTE) of the substrate-film couple. The residual film stress and the propensity for films to crack during cooldown depends principally on the substrate material when using identical process parameters. Films deposited onto quartz substrates show evidence of stress relief during cooldown due to a large CTE misfit; this is correlated with crack nucleation and propagation within films. All ScD2 layers remain in a state of tension when cooled to 30 C. An in-situ, laser-based, wafer curvature sensor is designed and implemented for studies of ScD2 film stress during processing. This instrument uses a two-dimensional array of laser beams to noninvasively monitor stress during sample rotation and with samples stationary. Film stress is monitored by scattering light off the backside of substrates, i.e., side opposite of the deposition flux.
NTIS
*Evaporation; Fabrication; Substrates; Tensile Stress; Thin Films; Scandium Compounds*

**20020016288** Oak Ridge National Lab., TN USA
**Bilayer Conductive-Oxide Buffer Layer Structures for High-Jc YBa2Cu3O7-d Coated Conductors**
Aytug, T.; Apr. 23, 2001; 4p; In English
Report No.(s): DE2001-787732; P01-110596; No Copyright; Avail: Department of Energy Information Bridge
Epitaxial, conductive-oxide buffer layers having bilayer configurations have been deposited on biaxially texture nickel substrates (RABiTS) by rf and dc-sputter techniques. The conductive bilayer structures comprise the layer sequences of SRRuO3/LaNiO3/Ni and SRRuO3/Cu/Ni. Systematic property characterizations of the buffer layers showed excellent electrical

and structural properties. High-quality epitaxial Yba2Cu3O7-5 (YBCO) films grown by pulsed-laser deposition on these structures exhibited critical current densities (Jc) as high as 1.3 x 10(exp 6) A/sq cm at 77 K in self-field.
NTIS
*Layers; Buffer Storage; Thin Films; Epitaxy; Oxides; Superconducting Films; Electrical Properties*

**20020016289** Oak Ridge National Lab., TN USA
**Inelastic Neutron Scattering Measurements of Phonon Dispersion Relations in Andalusite and Sillimanite, Al2SiO5**
Goel, P.; Apr. 24, 2001; 3p; In English
Report No.(s): DE2001-787731; P01-110466; No Copyright; Avail: Department of Energy Information Bridge
This paper reports inelastic neutron scattering (INS) measurements of the phonon dispersion relations of the aluminium silicate minerals andalusite and sillimanite, Al2SiO5. The single crystal INS measurements were undertaken using the Triple-axis-spectrometer at the Dhruva reactor, Trombay for andalusite and at the Oak Ridge National Laboratory, U.S.A. for sillimanite. The phonon dispersion relations (up to 50 meV) along various high symmetry directions have been measured and have been analyzed on the basis of lattice dynamics shell model calculations. The calculated structure factors based on the model calculations were used as guides for planning these single crystal measurements and were used to identify regions in reciprocal space with large cross-sections. The calculated structure factors have been very useful in the planning, execution and analysis of the experimental data. The calculated phonon dispersion relations are found to be in good agreement with the measured data.
NTIS
*Neutron Scattering; Crystal Lattices; Electromagnetic Measurement; Rigid Structures; Inelastic Scattering*

**20020016290** Oak Ridge National Lab., TN USA
**High Current Density YBCO Coated Conductors On Strengthened Biaxially Textured Ni-W Substrates**
Paranthaman, M.; May 29, 2001; 3p; In English
Report No.(s): DE2001-787478; P01-110895; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
High current density YBa2Cu3O7-(delta)) (YBCO) films were fabricated on rolling-assisted biaxially textured substrates (RABiTS) with a layer sequence of CeO2/YSZ/(dip-coated or e-beam seed)/Ni-W (3 at.%). Electron-beam evaporation was used to deposit Y2O3 seed layers. A reel-to-reel continuous dip-coating unit was used to deposit Gd2O3 and La2Zr2O7 (LZO) seed layers. Scanning Auger Microprobe analysis of the textured Ni-W substrates indicated the presence of sulfur segregation at the surface. This possibly facilitated the growth of epitaxial e-beam Y2O3 seed layers directly on Ni-W substrates through sulfur c2x2 superstructure. Highly aligned, continuous and crack-free Y2O3 Gd2O3, LZO seed layers were obtained. Both YSZ and CeO2 cap layers were deposited on all of these seed layers using rf-magnetron sputtering. The YBCO films were then grown on these buffered Ni-W substrates by either pulsed laser deposition (PLD) or ex-situ BaF2 precursor process. A high Jc of 1.9 MA/per square centimeter at 77 K and self-field was obtained on both Y2O3 and LZO seed layers. The performance of solution seed layers approached that of the vacuum seed layers.
NTIS
*Current Density; Fabrication; Substrates; YBCO Superconductors; Coatings; Tungsten Alloys; Nickel Alloys*

**20020016380** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Electronic Damping of Microphonics in Superconducting Cavities**
Delayen, J. R.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783670; JLAB-ACT-01-11; DOE/ER/40150-1885; No Copyright; Avail: Department of Energy Information Bridge
In previous applications of high-velocity superconducting cavities the accelerated beam currents were sufficiently high that the microphonics-induced frequency excursions were significantly less than the loaded bandwidth, and the power absorbed by the beam dominated the total power requirement. In new applications (CEBAF Upgrade, RIA) the beam currents will be sufficiently low that the RF power requirements will be dominated by the control of the cavity fields in the presence of microphonics. Active electronic damping of microphonics by modulation of the cavity field amplitude has been occasionally used in the past in small, low-velocity, low-gradient superconducting structures; its application to much larger, high-velocity, high-gradient structures could result in a substantial reduction of the RF power requirements. This paper presents an analytical study of various schemes for electronic damping and presents formulae that quantify the reduction of microphonics as a function of RF field amplitude modulation.
NTIS
*Superconducting Cavity Resonators; Damping; Active Control*

**20020016412** Department of Energy, Aiken, SC USA

**Melt Rate Improvement for DWPF MB3: Melt Rate Furnace Testing**

Stone, M. E.; Jul. 24, 2001; 110p; In English

Report No.(s): DE2001-783821; WSRC-TR-2001-00146; No Copyright; Avail: Department of Energy Information Bridge

The Defense Waste Processing Facility (DWPF) would like to increase its canister production rate. The goal of this study is to improve the melt rate in DWPF specifically for Macrobatch 3. However, the knowledge gained may result in improved melting efficiencies translating to future DWPF macrobatches and in higher throughput for other Department of Energy's (DOE) melters. Increased melting efficiencies decrease overall operational costs by reducing the immobilization campaign time for a particular waste stream. For melt rate limited systems, a small increase in melting efficiency translates into significant hard dollar savings by reducing life cycle operational costs.

NTIS

*Radioactive Wastes; Melting*

**20020016413** Department of Energy, Aiken, SC USA

**Melt Rate Improvement for DWPF MB3: Foaming Theory and Mitigation Techniques**

Peeler, D. K.; Jul. 24, 2001; 31p; In English

Report No.(s): DE2001-783820; WSRC-RP-2001-00351; No Copyright; Avail: Department of Energy Information Bridge

The objective of this research is to enhance the basic understanding of the role of glass chemistry, including the chemical kinetics of pre-melting, solid state reactions, batch melting, and the reaction pathways in glass and/or acid addition strategy changes on the overall melting process for the Defense Waste Processing Facility (DWPF) Macrobatch 3 (MB3).

NTIS

*Radioactive Wastes; Glass; Melting*

**20020016426** Brookhaven National Lab., Upton, NY USA

**Design and development of the SNS ring vacuum instrumentation and control systems**

Hseuh,; Smart,; Tang,; Jun. 18, 2001; 3p; In English

Report No.(s): DE2001-783728; BNL-68041; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

BNL is undertaking the design, construction and commissioning of the Spallation Neutron Source (SNS) accumulator ring and the beam transport lines (l). Ultrahigh vacuum of 10(sup (minus)9) Torr is required in the accumulator ring to minimize beam-gas ionization, a contributing factor to the e-p instability observed in a few high-intensity proton storage rings. All vacuum instrumentation must be capable of local and remote operation to achieve a reliable vacuum system, especially in this extremely high intensity accelerator. The design and development of the SNS ring vacuum instrumentation and control through the Experimental Physics and Industrial Control System (EPICS) distributed real-time software tools are presented.

NTIS

*Vacuum Systems; Storage Rings (Particle Accelerators); Neutron Sources; Spallation; Instruments; Control*

**20020016441** Argonne National Lab., IL USA

**High-power testing of 11.424 GHz dielectric-loaded accelerating structures**

Gold, S. H.; Gai, W.; Jul. 16, 2001; 3p; In English

Report No.(s): DE2001-783657; ANL-HEP-CP-01-61; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The design, construction, and bench testing of an X-band travelling-wave accelerating structure loaded with a permittivity=20 dielectric has been published recently by the Argonne Advanced Accelerator Group. Here we describe a new program to build a test accelerator using this structure. The accelerator will be powered using high-power 11.424-GHz radiation available at the Magnicon Facility at the Naval Research Lab. The magnicon is expected to provide up to 30 MW from each of two WR-90 output waveguide arms in pulses of up to 1-microsecond duration, permitting tests of the dielectric-loaded X-band device at gradients of approximately 40 MV/m. The use of higher power pulses (100-500 MW) eventually available at the output of an active pulse compressor driven by the magnicon will permit gradients in excess of 100 MV/m to be achieved.

NTIS

*Dielectrics; Traveling Waves; Superhigh Frequencies*

**20020016444** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Testing Procedures and Results of the Prototype Fundamental Power Coupler for the Spallation Neutron Source**

Stirbet, M.; Campisi, I. E.; Daly, E. F.; Davis, G. K.; Drury, M.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783628; JLAB-ACT-01-06; DOE/ER/40150-1880,LA-UR 01-315; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

High-power RF testing with peak power in excess of 500 kW has been performed on prototype Fundamental Power Couplers (FPC) for the Spallation Neutron Source superconducting (SNS) cavities. The testing followed the development of procedures for cleaning, assembling and preparing the FPC for installation in the test stand. The qualification of the couplers has occurred for the time being only in a limited set of conditions (travelling wave, 20 pps) as the available RF system and control instrumentation are under improvement.

NTIS

*Couplers; Test Stands; Neutron Sources; Spallation*

**20020016480** HRL Labs., LLC, Malibu, CA USA

**Heteroepitaxy on Compliant Substrates for Vertical and Horizontal Integration of Multi-Functional Devices** ***Final Report, 15 Oct. 1998***

Olson, G. L.; Roth, J. A.; de Lyon, T. J.; Jensen, J. E.; Speck, J. S.; Oct. 10, 2001; 49p; In English

Contract(s)/Grant(s): F49620-99-C-0004

Report No.(s): AD-A396777; AFRL-SR-BL-TR-01-0592; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents the results of research on compliant substrate behavior in III-V semiconductors grown by molecular beam epitaxy (MBE) on thin (50-80A) InGaAs layers on GaAs, and in II-VI semiconductors (HgCdTe, CdTe, ZnTe) grown on thin Si(211) layers on Si(100). A comprehensive experimental study was conducted utilizing spectroscopic ellipsometry, transmission electron microscopy, and atomic force microscopy at various stages in the fabrication and processing of the compliant layers and during MBE growth on those layers. Contrary to earlier reports by other investigators, we obtained no evidence for defect reduction or solid phase atomic rearrangement due to substrate compliance in either of the III-V or II-V systems studied here. We conclude that the early reports of compliancy may have been erroneous interpretation of limited experimental data. Indeed, a theoretical consideration of stress relief mechanics in semiconductor thin films suggests that many of the proposed compliancy mechanisms are not feasible. Although no evidence of substrate compliancy was obtained, we were nevertheless successful in growing high quality II-VI layers by MBE on thin Si(211) layers bonded to Si(100) substrates. This has important implications for monolithic integration of HgCdTe infrared focal plane arrays with readout circuitry fabricated in Si(100) substrates.

DTIC

*Substrates; Semiconductors (Materials); Film Thickness; Modulus of Elasticity; Thin Films*

**20020016666** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Fundamental Power Coupler for the Spallation Neutron Source (SNS) Superconducting Cavities**

Campisi, I. E.; Daly, E.; Kneisel, P.; Schneider, W.; Stirbet, M.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783673; JLAB-ACT-01-14; DOE/ER/40150-1888; No Copyright; Avail: Department of Energy Information Bridge

The Spallation Neutron Source (SNS) linac contains superconducting cavities with phase velocities 0.61 and 0.81 for the acceleration of H-ions. Each of the six-cell cavities, resonant at 805 MHz at 2 K, is powered by a 550 kW pulsed klystron via a coaxial coupler. The specifications for the coupler require that it withstand the full klystron power in full reflection for the duration of the radio frequency (RF) pulse (1.3+1.5(decay) ms) at a repetition rate of 60 pps, with an average power of 48 kW. The coupler must provide a Qext of 7.3x10(exp 5) for the medium beta and high beta cavities, respectively. A design derived from proven experience at other laboratories (primarily at KEK, for Tristan and KEK-B cavities at 508 MHz) has been adopted for the production of the 50 omega prototype couplers. The couplers include a planar coaxial window with matching compensation elements, cooled by conduction via a water system from the air side of the inner conductor. The coupler's outer conductor between the window and the cavity is actively cooled by a helium circuit with input at 5 K and output at about 165 K. Vacuum, arcing, infrared, and electron current monitoring and interlocking is done through several ports located near the window. The coaxial coupler is matched to a WR975 waveguide through a door-knob transition, also derived from the KEK design. Numerical calculations have been performed on the electromagnetic properties of the coupler and on the multipacting behavior of the coaxial line and window. A capacitor for DC bias will be used to control multipacting. The first coupler prototypes have been produced by industry and the results of the RF testing on them at room temperature will be presented.

NTIS

*Couplers; Superconducting Cavity Resonators; Linear Accelerators; Performance Tests*

**20020016667** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**Electromagnetic Simulations and Properties of the Fundamental Power Couplers for the SNS Superconducting Cavities**

Kang, Y.; Kim, S.; Doleans, M.; Campisi, I. E.; Stirbet, M.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783672; JLAB-ACT-01-13; DOE/ER/40150-1887; No Copyright; Avail: Department of Energy Information Bridge

The Spallation Neutron Source (SNS) makes use of superconducting cavities for the acceleration of negative H ions in the main linac. Two types of six-cell Niobium cavities are used in the superconducting portion of the linac: 33 Beta = 0.61 cavities and 48 Beta = 0.81 cavities. Each cavity is powered via a coaxial fundamental power coupler (FPC) of a simple yet robust design. The electromagnetic design of the main components of that coupler has been modeled and some of those properties have been measured experimentally. Modeling includes impedance matching of the window and of the waveguide to coaxial doorknow transition; coupling of the coupler fields to the cavity fields; and multipacting behavior of the coaxial line and window. Various aspects of design, simulation, and testing on the coupler and cavity are presented.

NTIS

*Couplers; Neutron Sources; Superconducting Cavity Resonators; Computerized Simulation*

**20020016674** Brookhaven National Lab., Upton, NY USA

**Can recent charge fluctuation calculations be a reliable signal for a qgp at RHIC**

Lindenbaum,; Longacre,; Aug. 01, 2001; 11p; In English

Report No.(s): DE2001-785042; BNL-52636; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The recent papers of Jeon and Koch and Asakawa, Heinz and Muller propose that the event by event fluctuations of the ratio of the positively charged and negatively charged pions could provide a distinct signal for a QGP at RHIC/LHC due to differences in those from the QGP phase, and the Hadron Gas Phase. In this pa- per we point out that aside from the questionability of the many assumptions in the treatment used, even following their approach there are other effects not considered, e.g. color charge fluctuations which we show could significantly or completely wash out the proposed signal. Therefore lack of observation of these charge fluctuation signals cannot lead one to conclude that a QGP is not formed at RHIC. A general discussion of experimental requirements for observation of such signals (if they exist) and how to interpret them is included.

NTIS

*Charged Particles; Vapor Phases; Hadrons*

**20020016678** Fermi National Accelerator Lab., Batavia, IL USA

**Effect of partially reacting Nb3Sn before magnet winding on the strand critical current**

Rey, J. M.; Aug. 24, 2001; 6p; In English

Report No.(s): DE2001-784995; FERMILAB-CONF-01/216-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Nb3Sn is currently the material most commonly foreseen for the development of high field superconducting magnets. This is done by either the wind and react technique, usually used for compact magnets like accelerator magnets, or the react and wind technique, more common on large scale magnets. In both cases, a thorough understanding of the Cu-Sn system diffusion and phase formation processes is necessary to optimize the Nb3Sn reaction cycle. Attention has to be paid to both the superconducting performance and the prevention of thermally induced damage of the final produced conductor. The formation of the eta and epsilon phases of the Cu-Sn phase diagram were investigated as a function of time and temperature. Wherever possible, the activation energies and diffusion coefficients were calculated. The feasibility of winding partly reacted cables to reduce the manufacturing time was also explored. Nb3Sn strands have been partially reacted to convert the Sn to the eta and epsilon phases of the Cu-Sn phase diagram, then plastically strained to figure out a cabling and/or a winding degradation. After completion of the reaction cycle, the critical current was measured and compared with that obtained with an uninterrupted cycle.

NTIS

*Niobium; Tin; Superconducting Magnets; Critical Current; Activation Energy; Temperature Effects*

**20020017465** Polish Academy of Sciences, Warsaw Inst. of Physics, Warsaw, Poland

**Influence of Electronic Structure on the Magnetic Properties of IV-VI diluted Magnetic Semiconductors** ***Final Report***

Gorska, Malgorzata, Polish Academy of Sciences, Poland; Oct. 2001; 17p; In English

Contract(s)/Grant(s): N68171-00-M-5929

Report No.(s): AD-A396782; R/D-8703-PH-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We investigated the magnetic and thermal properties of chalcogenide-based diluted magnetic semiconductor (DMS) systems. These systems have been considered as possible novel materials with increased magnetic sensitivity and thermoelectric efficiency.

Measurements of the magnetic properties of Sn(1-x) Gd(x)Te show that there is an antiferromagnetic pair-exchange interaction with a maximum in the magnitude at a hole concentration of about 3 x 10(exp 20) /cu cm. The interpretation of this result is based on the relative positions of the Gd 5d level, the Fermi level, and the L and sum sigma levels in the valence band. We have also measured the low-temperature specific heat in these DMS systems. Theoretical calculations have shown that one must take into account the systems of magnetic ions and the carriers and the interactions between them in order to obtain an approximate fit to the data. We have performed measurements of the thermoelectric power, thermoelectric figure of merit, and electrical conductivity in P(1-x)Mn(x)Te. The thermoelectric power increased as the Mn-content increased, but a decrease in the carrier mobility limited the thermoelectric figure of merit. In new quaternary and pentenary DMS we have observed a paramagnet - ferromagnet transition and a temperature dependent anomalous Hall effect.
DTIC
*Chalcogenides; Electrical Resistivity; Electronic Structure; Magnetic Properties; Semiconductors (Materials); Temperature Dependence; Thermodynamic Properties*

**20020017579** NASA Marshall Space Flight Center, Huntsville, AL USA
**Macromolecular Crystal Quality**
Snell, Edward H., NASA Marshall Space Flight Center, USA; Borgstahl, Gloria E. O., Toledo Univ., USA; Bellamy, Henry D., Stanford Univ., USA; [2001]; 26p; In English
Contract(s)/Grant(s): NAG8-1380; NAG8-1825; NAG8-1836; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
There are many ways of judging a good crystal. Which we use depends on the qualities we seek. For gemstones size, clarity and impurity levels (color) are paramount. For the semiconductor industry purity is probably the most important quality. For the structural crystallographer the primary desideratum is the somewhat more subtle concept of internal order. In this chapter we discuss the effect of internal order (or the lack of it) on the crystal's diffraction properties.
Derived from text
*Crystals; Diffraction; Crystal Defects; Q Factors*

**20020017758** NASA Marshall Space Flight Center, Huntsville, AL USA
**Band Anticrossing in Highly Mismatched Compound Semiconductor Alloys**
Yu, Kin Man, California Univ., Lawrence Berkeley Lab., USA; Wu, J., NASA Marshall Space Flight Center, USA; Walukiewicz, W., California Univ., Lawrence Berkeley Lab., USA; Ager, J. W., California Univ., Lawrence Berkeley Lab., USA; Haller, E. E., NASA Marshall Space Flight Center, USA; Miotkowski, I., Purdue Univ., USA; Ramdas, A., Purdue Univ., USA; Su, Ching-Hua, NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; 28th International Symposium on Compound Semiconductors, 2 Oct. 2001, Tokyo, Japan; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
Compound semiconductor alloys in which metallic anions are partially replaced with more electronegative isoelectronic atoms have recently attracted significant attention. Group IIIN(x)V(1-x), alloys with a small amount of the electronegative N substituting more metallic column V elements has been the most extensively studied class of such Highly Mismatched Alloys (HMAs). We have shown that many of the unusual properties of the IIIN(x),V(1-x) alloys can be well explained by the Band Anticrossing (BAC) model that describes the electronic structure in terms of an interaction between highly localized levels of substitutional N and the extended states of the host semiconductor matrix. Most recently the BAC model has been also used to explain similar modifications of the electronic band structure observed in Te-rich ZnS(x)Te(l-x) and ZnSe(Y)Te(1-y) alloys. to date studies of HMAs have been limited to materials with relatively small concentrations of highly electronegative atoms. Here we report investigations of the electronic structure of ZnSe(y)Te(1-y) alloys in the entire composition range, 0 less than or equal to y less than or equal to 1. The samples used in this study are bulk ZnSe(y)Te(1-y) crystals grown by either a modified Bridgman method or by physical vapor transport. Photomodulated reflection (PR) spectroscopy was used to measure the composition dependence of optical transitions from the valence band edge and from the spin-orbit split off band to the conduction band. The pressure dependence of the band gap was measured using optical absorption in a diamond anvil cell. We find that the energy of the spin-orbit split off valence band edge does not depend on composition and is located at about 3 eV below the conduction band edge of ZnSe. On the Te-rich side the pressure and the composition dependence of the optical transitions are well explained by the BAC model which describes the downward shift of the conduction band edge in terms of the interaction between localized Se states and the conduction band. On the other hand we show that the large band gap reduction observed on the Se-rich side of the alloy system is a result of an interaction between the localized Te level and the valence bands. This interaction leads to the formation of a Te-like valence band edge that strongly interacts with the light hole valence band. Calculations based on a modified k p model account for the reduction of the band gap and the large increase of the spin-orbit splitting observed in Se-rich

ZnSe(y)Te(l-y) alloys. We will also discuss the importance of these new results for understanding of the electronic structure and band offsets in other highly mismatched alloy systems.
Author
*Semiconductors (Materials); Isoelectronic Sequence; Alloying; Zinc Tellurides; Mathematical Models; Selenium Alloys*

**20020017971** Brookhaven National Lab., Upton, NY USA
**Microstructure of superconducting MgB2**
Zhu,; Li,; Wu,; Volkov,; Gu,; Jul. 12, 2001; 20p; In English
Report No.(s): DE2001-787625; BNL-68427; KC0201030; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recently, Akimitsu and co-workers discovered superconductivity at 39 K in the intermetallic compound MgB(sub 2). This discovery provides a new perspective on the mechanism for superconductivity. More specifically, it opens up possibilities for investigation of structure/properties in a new class of materials. With the exceptions of the cuprate and C(sub 60) families of compounds, MgB(sub 2) possesses the highest superconducting transition temperature T(sub c). Its superconductivity appears to follow the BCS (Bardeen-Cooper-Schrieffer) theory, apparently being mediated by electron-phonon coupling. The coherence length of MgB(sub 2) is reported to be longer than that of the cuprates (2). In contrast to the cuprates, grain boundaries are strongly coupled and current density is determined by flux pinning. Presently, samples of MgB(sub 2) commonly display inhomogeneity and porosity on the nanoscale, and are untextured. In spite of these obstacles, magnetization and transport measurements show that polycrystalline samples may carry large current densities circulating across many grains. Very high values of critical current densities and critical fields have been recently observed in thin films. These attributes suggest possible large scale and electronic applications. The underlying microstructure can be intriguing, both in terms of basic science and in applied areas. Subsequent to the discovery, many papers were published, most dealing with synthesis, physical properties, and theory. There have yet been few studies of microstructure and structural defects. A thorough understanding of practical superconducting properties can only be developed after an understanding of microstructure is gained. In this work we review transmission electron microscopy (TEM) studies of sintered MgB(sub 2) pellets. Structural defects, including second phase particles, dislocations, stacking faults, and grain boundaries, are analyzed using electron diffraction, electron-energy loss spectroscopy (EELS), high resolution imaging, and structural modeling.
NTIS
*Microstructure; Magnesium Compounds; Superconductors (Materials); Borides; Superconductivity*

**20020017996** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Design of the SNS Cavity Support Structure**
Hogan, J.; Ciovati, G.; Machie, D.; Pitts, J.; Preble, J.; Jun. 01, 2001; 2p; In English
Report No.(s): DE2001-783614; JLAB-ACE-01-02; DOE/ER/40150-1867; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Spallation Neutron Source (SNS) facility utilizes a superconducting linac to provide a 1-GeV H- beam with an average power of 2MW. A critical part of the accelerator structure is the superconducting radio frequency (SRF) niobium cavities which are housed in a titanium liquid helium pressure vessel. These vessels maintain the operating temperature of 2.1 Kelvin while facilitating the mechanical support, tuning and alignment of the SRF cavities. The design, fabrication and operation of the superconducting support structure will be presented with an emphasis on the design criteria as they pertain to the operation of the cavity. These criteria will be discussed with respect to the titanium liquid helium pressure vessels, higher order mode couplers, fundamental power coupler, field probe and tuning requirements.
NTIS
*Laser Cavities; Superconducting Devices; Linear Accelerators*

**20020018146** Tetrad Corp., Englewood, CO USA
**Application of Bonded Multilayer Technology to Relaxor-Based Single Crystals for Imaging Transducer Applications *Final Report, Mar.-Nov. 2001***
Zipparo, Michael J.; Nov. 26, 2001; 11p; In English
Contract(s)/Grant(s): DAAH01-01-C-R141; ARPA Order K475; Proj. 646F
Report No.(s): AD-A396874; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this program was to evaluate the performance of single crystal materials processed in the form of multilayer crystals and crystal-composites. These multilayers have been fabricated using a process originally developed for polycrystalline ceramic. All of the multilayers were found to function with the expected four-and nine-fold increase in the effective dielectric

constant. The coupling was found to vary considerably between different multilayer sizes and between different array element samples diced from the same multilayers. SEM analysis of the multilayers and of bulk material found evidence of crystal defects which likely contributed to some degradation in performance. The crystal- and crystal-composite multilayers were found to be considerably better than similar multilayers fabricated with ceramic materials. The KLM model has been used to predict the performance of array elements. Using the measured properties for 2-layer crystals and 3-layer crystal-composites, very wide bandwidth (greater than 120%) and very good insertion loss (-18 dB) have been modeled. Because of the lower coupling measured for the crystal-composites, they did not show better bandwidth or sensitivity than the multilayer crystal. Improvements in crystal quality and a corresponding decrease in processing damage should improve the performance of multilayer crystal-composites, resulting in even better array performance.
DTIC
*Ceramics; Imaging Techniques; Single Crystals; Transducers; Crystal Defects; Laminates*

**20020018172** Brookhaven National Lab., Upton, NY USA
**BaF(2) Post-Deposition Reaction Process For Thick YBCO Films**
Suenaga,; Solovyov, F.; Wu,; Wiesmann, J.; Zhu,; Jul. 12, 2001; 12p; In English
Report No.(s): DE2001-787624; BNL-68426; KC0201030; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The basic processes of the so-called BaF(sub 2) process for the formation of YBa(sub 2)Cu(sub 3)O(sub 7) (YBCO) films as well as its advantages over the in situ formation processes are discussed in the previous chapter. The process and the properties of YBCO films by this process were also nicely described in earlier articles by R. Feenstra, et al. Here, we will discuss two pertinent subjects related to fabrication of technologically viable YBCO conductors using this process. These are (1) the growth of thick (1 (micro)m) c-axis-oriented YBCO films and (2) their growth rates. Before the detail discussions of these subjects are given, we first briefly discuss what geometrical structure a YBCO-coated conductor should be. Then, we will provide examples of simple arguments for how thick the YBCO films and how fast their growth rates need to be. Then, the discussions in the following two sections are devoted to: (1) the present understanding of the nucleation and the growth process for YBCO, and why it is so difficult to grow thick c-axis-oriented films (greater than 3 (micro)m), and (2) our present understanding of the YBCO growth-limiting mechanism and methods to increase the growth rates. The values of critical-current densities J(sub c) in these films are of primary importance for the applications, and the above two subjects are intimately related to the control of J(sub c) of the films. In general, the lower the temperatures of the YBCO formation are, the higher the values of J(sub c) of the films. Thus, the present discussion is limited to those films which are reacted at (approx) 735 C. This is the lowest temperature at which c-axis-oriented YBCO films (1-3 (micro)m thick) are comfortably grown. It is also well known that the non-c-axis oriented YBCO platelets are extremely detrimental to the values of J(sub c) such that their effects on J(sub c) dwarf essentially all of other microstructural effects which control J(sub c). Hence, the discussion given below is mainly focused on how to avoid the growth of these crystallites when the films are thick and/or the growth rates are high.
NTIS
*Thin Films; Yttrium Oxides; Barium Oxides; Copper Oxides; YBCO Superconductors; Chemical Reactions*

**20020018174** Brookhaven National Lab., Upton, NY USA
**BaF(2) Post-Deposition Reaction Process For Thick YBCO Films**
Suenaga,; Solovyov, F.; Wu,; Wiesmann, J.; Zhu,; Jul. 12, 2001; 12p; In English
Report No.(s): DE2001-787614; BNL-68426; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The basic processes of the so-called BaF(sub 2) process for the formation of YBa(sub 2)Cu(sub 3)O(sub 7) (YBCO) films as well as its advantages over the in situ formation processes are discussed in the previous chapter. The process and the properties of YBCO films by this process were also nicely described in earlier articles by R. Feenstra, et al. Here, we will discuss two pertinent subjects related to fabrication of technologically viable YBCO conductors using this process. These are (1) the growth of thick approximately 1 (micro)m c-axis-oriented YBCO films and (2) their growth rates. Before the detail discussions of these subjects are given, we first briefly discuss what geometrical structure a YBCO-coated conductor should be. Then, we will provide examples of simple arguments for how thick the YBCO films and how fast their growth rates need to be. Then, the discussions in the following two sections are devoted to: (1) the present understanding of the nucleation and the growth process for YBCO, and why it is so difficult to grow thick c-axis-oriented films (greater than 3 (micro)m), and (2) our present understanding of the YBCO growth-limiting mechanism and methods to increase the growth rates. The values of critical-current densities J(sub c) in these films are of primary importance for the applications, and the above two subjects are intimately related to the control of J(sub c) of the films. In general, the lower the temperatures of the YBCO formation are the higher the values of J(sub c) of the films. Thus, the present discussion is limited to those films which are reacted at (approx) 735 C. This is the lowest temperature at which

c-axis-oriented YBCO films (1-3 (micro)m thick) are comfortably grown. It is also well known that the non-c-axis oriented YBCO platelets are extremely detrimental to the values of J(sub c) such that their effects on J(sub c) dwarf essentially all of other microstructural effects which control J(sub c). Hence, the discussion given below is mainly focused on how to avoid the growth of these crystallites when the films are thick and/or the growth rates are high.
NTIS
*Thin Films; Chemical Reactions; YBCO Superconductors; Crystal Growth; Rates (Per Time)*

**20020018882** Alabama A & M Univ., Center for Irradiation of Materials, Normal, AL USA
**Low Temperature Ohmic Contact Formation of Ni2Si on N-type 4H-SiC and 6H-SiC**
Elsamadicy, A. M., Alabama A & M Univ., USA; Ila, D., Alabama A & M Univ., USA; Zimmerman, R., Alabama A & M Univ., USA; Muntele, C., Alabama A & M Univ., USA; Evelyn, L., Alabama A & M Univ., USA; Muntele, I., Alabama A & M Univ., USA; Poker, D. B., Alabama A & M Univ., USA; Hensley, D., Alabama A & M Univ., USA; Hirvonen, J. K., Alabama A & M Univ., USA; Demaree, J. D., Alabama A & M Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 9; In English; Also announced as 20020018881
Report No.(s): P1; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Nickel Silicide (Ni2Si) is investigated as possible ohmic contact to heavily nitrogen-doped N-type 4H-SiC and 6H-SiC. Nickel Silicide was deposited via electron gun with various thicknesses on both Si and C faces of the SiC substrates. The Ni2Si contacts were formed at room temperature as well as at elevated temperatures (400 to 1000 K). Contact resistivities and I-V characteristics were measured at temperatures between 100 and 700 C. To investigate the electric properties, I-V characteristics were studied and the Transmission Line Method (TLM) was used to determine the specific contact resistance for the samples at each annealing temperature. Both Rutherford Backscattering Spectroscopy (RBS) and Auger Electron Spectroscopy (AES) were used for depth profiling of the Ni2Si, Si, and C. X-ray Photoemission Spectroscopy (XPS) was used to study the chemical structure of the Ni2Si/SiC interface.
Author
*Electric Contacts; Nickel; Silicides*

**20020018883** Alabama A & M Univ., Center for Irradiation of Materials, Normal, AL USA
**Raman and FTIR Studies of Silicon Carbide Surface Damage from Palladium Implantation in Presence of Hydrogen**
Muntele, I., Alabama A & M Univ., USA; Ila, D., Alabama A & M Univ., USA; Muntele, C. J., Alabama A & M Univ., USA; Poker, D. B., Alabama A & M Univ., USA; Hensley, D. K., Alabama A & M Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 10; In English; Also announced as 20020018881
Report No.(s): P2; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The ion implantation in a crystal such as silicon carbide will cause both damage in the ion track and in the substrate at the end of the ion track. We used both keV, and MeV Pd ions in fabricating electronic chemical sensors in silicon carbide, which can operate at elevated temperatures. In order to study the feasibility of fabricating an optical chemical sensor (litmus sensor), we need to understand the optical behavior of the embedded damage in the presence of hydrogen, as well as the potential chemical interaction of silicon carbide broken lattice bonds with the hydrogen dissociated from gas by palladium. Implanted samples of silicon carbide were studied using both Raman spectroscopy and FTIR (Fourier Transform-Infrared). The results of this work will be presented during the meeting.
Author
*Silicon Carbides; Palladium; Ion Implantation; Crystal Defects*

**20020018893** NASA Glenn Research Center, Cleveland, OH USA
**Functionalized Carbon Nanotubes**
Lebron, Marisabel, Clark-Atlanta Univ., USA; Mintz, Eric, Clark-Atlanta Univ., USA; Meador, Michael A., NASA Glenn Research Center, USA; Hull, David R., NASA Glenn Research Center, USA; Scheiman, Daniel A., DYNACS Engineering Co., Inc., USA; Willis, Peter, Rice Univ., USA; Smalley, Richard E., Rice Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 20; In English; Also announced as 20020018881
Report No.(s): P12; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Carbon nanotubes have created a great deal of excitement in the Materials Science community because of their outstanding mechanical, electrical, and thermal properties. Use of carbon nanotubes as reinforcements for polymers could lead to a new class of composite materials with properties, durability, and performance far exceeding that of conventional fiber reinforced composites. Organized arrays of carbon nanotubes, e.g., nanotube monolayers, could find applications as thermal management materials, light emitting devices, and sensor arrays. Carbon nanotubes could also be used as templates upon which nanotubes from

other materials could be constructed. Successful use of carbon nanotubes in any of these potential applications requires the ability to control the interactions of nanotubes with each other and with other materials, e.g., a polymer matrix. One approach to achieving this control is to attach certain chemical groups to the ends and/or side-walls of the nanotubes. The nature of these chemical groups can be varied to achieve the desired result, such as better adhesion between the nanotubes and a polymer. Under a joint program between NASA Glenn, Clark Atlanta University, and Rice University researchers are working on developing a chemistry ”tool-kit” that will enable the functionalization of carbon nanotubes with a variety of chemical groups. Recent results of this effort will be discussed.
Author
*Carbon Nanotubes; Nanostructure (Characteristics)*

**20020020982** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Theory and Development of Position-Sensitive Quantum Calorimeters**
Figueroa-Feliciano, Enectalf, NASA Goddard Space Flight Center, USA; October 2001; 216p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 662-00-00
Report No.(s): NASA/TM-2001-209994; Rept-2002-00289-0; NAS 1.15:209994; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Quantum calorimeters are being developed as imaging spectrometers for future X-ray astrophysics observatories. Much of the science to be done by these instruments could benefit greatly from larger focal-plane coverage of the detector (without increasing pixel size). An order of magnitude more area will greatly increase the science throughput of these future instruments. One of the main deterrents to achieving this goal is the complexity of the readout schemes involved. We have devised a way to increase the number of pixels from the current baseline designs by an order of magnitude without increasing the number of channels required for readout. The instrument is a high energy resolution, distributed-readout imaging spectrometer called a Position-Sensitive Transition-Edge Sensor (POST). A POST is a quantum calorimeter consisting of two Transition-Edge Sensors (TESS) on the ends of a long absorber capable of one-dimensional imaging spectroscopy. Comparing rise time and energy information from the two TESS, the position of the event in the POST is determined. The energy of the event is inferred from the sum of the two pulses. We have developed a generalized theoretical formalism for distributed-readout calorimeters and apply it to our devices. We derive the noise theory and calculate the theoretical energy resolution of a POST. Our calculations show that a 7-pixel POST with 6 keV saturation energy can achieve 2.3 eV resolution, making this a competitive design for future quantum calorimeter instruments. For this thesis we fabricated 7- and 15-pixel POSTS using Mo/Au TESs and gold absorbers, and moved from concept drawings on scraps of napkins to a 32 eV energy resolution at 1.5 keV, 7-pixel POST calorimeter.
Author
*Calorimeters; Imaging Spectrometers; X Ray Detectors; Quantum Electronics; Focal Plane Devices; Readout*

**20020020993** National Defence Research Establishment, Div. of Sensor Technology, Linkoeping, Sweden
**Study of a Three-Dimensional Photonic Band-Gap Material in the Microwave Region**
Fagerstroem, J.; Leijon, S.; Gustafsson, N.; Martin, T.; Jun. 2000; ISSN 1104-9154; 46p; In English
Report No.(s): PB2002-100645; FOA-R-00-01566-408-SE; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A microwave photonic crystal has been constructed and characterized experimentally and computationally. The material has prominent electromagnetic features characteristic of a three-dimensional photonic band structure material. Measurements of transmission and reflection coefficients show that the material has a first band-gap (i.e., a frequency gap where extended modes are forbidden) between 10.9-13.1 GHz. The damping of transmitted amplitude is typically -40 dB in this band-gap, and close to 0 dB (with dips due to interference effects reaching down to -8 db) within the bands (i.e. at frequencies where extended modes are allowed). Calculated transmission and reflection spectra agree qualitatively with measurements. The electric flux density and the time average Poynting vector (flow of electromagnetic power), have been calculated on a plane cut, parallel to the direction of incidence, through a model of the photonic crystal. Close to the first band-gap, the electric flux density amplitude has properties characteristic of standing wave modes in photonic band-gap crystals. It particular, the high-epsilon (sub tau) regions contain amplitude nodes right above the gap, and amplitude maxima right below the gap.
NTIS
*Photonics; Energy Gaps (Solid State); Microwave Frequencies; Three Dimensional Models; Electromagnetic Fields*

## 77
## PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

*Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also 72 Atomic and Molecular Physics, 73 Nuclear Physics, and 25 Inorganic, Organic and Physical Chemistry.*

**20020016144** Brookhaven National Lab., Upton, NY USA
**Enhancement of nsls sextupoles using permanent magnets**
Rakowsky,; Jun. 18, 2001; 5p; In English
Report No.(s): DE2001-783180; BNL-68405; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The recent upgrade of the NSLS (National Synchrotron Light Source) X-Ray Ring energy from 2.584 to 2.8 GeV requires defocusing sextupole fields beyond the operating limits of the present sextupole magnets. We have demonstrated that the required fields can be achieved by addition of permanent magnets to counteract the saturation in the magnet poles. Magnetic measurements on a NSLS sextupole agree with fields predicted by Radia.
NTIS
*Permanent Magnets; Multipoles; Synchrotrons; Light Sources*

**20020016297** Fermi National Accelerator Lab., Batavia, IL USA
**Status of the Fermilab Main Injector**
Koba, K.; Jul. 24, 2001; 3p; In English
Report No.(s): DE2001-783190; FERMILAB-CONF-01/184-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Fermilab Main Injector is a rapid cycling proton synchrotron. It is designed to accelerate protons and antiprotons to 150GeV. The initial commissioning phase was in the summer of 1999. Since then, Main Injector has been supporting the high energy physics program at Fermilab. Beam studies for continued improvements in machine performance are in progress, in order to support a luminosity of 8 x 10(sup 31) cm(sup (minus)2) sec(sup (minus)1) during Run IIa. The status of the Main Injector and beam studies results are presented.
NTIS
*Beam Injection; Synchrotrons; Proton Beams; Antiprotons*

**20020016375** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA
**High-speed nuclear quality pulse height analyzer for synchrotron-based applications**
Beche, J. F.; Bucher, J. J.; Fabris, L.; Riot, V. J.; Apr. 01, 2001; 2p; In English
Report No.(s): DE2001-783505; LBNL-47771; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A high throughput Pulse Height Analyzer system for synchrotron-based applications requiring high resolution, high processing speed and low dead time has been developed. The system is comprised of a 120ns 12-bit nuclear quality Analog to Digital converter with a self-adaptive fast peak detector-stretcher and a custom-made fast histogramming memory module that records and processes the digitized data. The histogramming module is packaged in a VME or VXI compatible interface. Data is transferred through a fast optical link from the memory interface to a computer. A dedicated data acquisition program matches the hardware characteristics of the histogramming memory module. The data acquisition system allows for two data collection modes: 'standard' data acquisition mode where the data is accumulated and read in synchronization with an external trigger and 'live' data acquisition mode where the system operates as a standard Pulse Height Analyzer. The acquisition, standard or live, can be performed on several channels simultaneously. A two-channel prototype has been demonstrated at the Stanford Synchrotron Radiation Laboratory accelerator in conjunction with an X-ray Fluorescence Absorption Spectroscopy experiment. A detailed description of the entire system is given and experimental data is shown.
NTIS
*Synchrotrons; Pulse Amplitude; Actuators; Analog to Digital Converters*

**20020016447** Fermi National Accelerator Lab., Batavia, IL USA
**Fast Injection Kicker System for the Tevatron**
Reilly, R. E.; Hanna, B. M.; Jul. 25, 2001; 3p; In English
Report No.(s): DE2001-783399; FERMILAB-CONF-01/150-E; No Copyright; Avail: Department of Energy Information Bridge

A new proton injection kicker system is required for the Tevatron in the Run 2 era. The new system was designed to supply 1.25 kG-m into a magnetic aperture of 48 mm vertical by 71 mm horizontal by 5 m long with a 396 ns bunch spacing. The system was designed to be upgraded to 132 ns bunch spacing with additional pulse supplies. The system design tradeoffs needed to meet

these goals is discussed. These include the system topology, the system impedance and the number of magnets. This system has been installed in the Tevatron.
NTIS
*Magnets; Particle Accelerators; Systems Engineering; Topology*

**20020016449** Fermi National Accelerator Lab., Batavia, IL USA
**Fast Injection Kicker Magnet for the Tevatron**
Hanna, B.; Reilly, R.; Jensen, C. C.; Jul. 25, 2001; 3p; In English
Report No.(s): DE2001-783397; FERMILAB-CONF-01/089-E; No Copyright; Avail: Department of Energy Information Bridge
A new proton injection kicker system is required for the Tevatron in the Run 2 era. The new system was designed to supply 1.25 kG-m into a magnetic aperture of 48 mm vertical by 71 mm horizontal by 5 m long with a 396 ns bunch spacing. The system was designed to be upgraded to 132 ns bunch spacing with additional pulse supplies. The design of the magnet incorporated some novel features in order to meet these requirements. These include adjustable bus spacing to set the inductance and balanced positive and negative high voltage buses. This system has been installed in the Tevatron.
NTIS
*Injection; Particle Accelerators; Magnets*

**20020016697** Brookhaven National Lab., Upton, NY USA
**Theoretical aspects of azimuthal and transverse spin asymmetries**
Mulders,; Henneman,; Boer,; Apr. 27, 2001; 6p; In English
Report No.(s): DE2001-783982; BNL-68421; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We use Lorentz invariance and the QCD equations of motion to study the evolution of functions that appear at leading (zeroth) order in a l/Q expansion in azimuthal asymmetries. This includes the evolution equation of the Collins fragmentation function. The moments of these functions are matrix elements of known twist two and twist three operators. We present the evolution in the large NC limit, restricted to the non-singlet case for the chiral-even functions.
NTIS
*Asymmetry; Lorentz Transformations; Quantum Chromodynamics; Spin*

**20020016874** Stanford Linear Accelerator Center, CA USA
**Linear Sigma Model Toolshed for D-brane Physics**
Hellerman, S.; Aug. 23, 2001; 20p; In English
Report No.(s): DE2001-787182; SLAC-PUB-8816; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Building on earlier work, we construct linear sigma models for strings on curved spaces in the presence of branes. Our models include an extremely general class of branes-worldvolume gauge field configurations. We explain in an accessible manner the mathematical ideas which suggest appropriate worldsheet interactions for generating a given open string background. This construction provides an explanation for the appearance of the derived category in D-branes physics complementary to the recent work of Douglas.
NTIS
*Mathematical Models; Gauge Invariance*

**20020016875** Stanford Linear Accelerator Center, CA USA
**D(NA)-Branes**
Hellerman, S.; Aug. 23, 2001; 17p; In English
Report No.(s): DE2001-787181; SLAC-PUB-8808; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Building on earlier work, we construct linear sigma models for strings on curved spaces in the presence of branes. Our models include an extremely general class of brane-worldvolume gauge field configurations. We explain in an accessible manner the mathematical ideas that suggest appropriate worldsheet interactions for generating a given open string background. This construction provides an explanation for the appearance of the derived category in D-brane physics complementary to that of recent work of Douglas.
NTIS
*Mathematical Models; Measuring Instruments*

**20020016876** Stanford Linear Accelerator Center, CA USA

**Quantum Hall Physics Equals Noncommutive Field Theory**

vanRammsdonk, M.; Aug. 09, 2001; 17p; In English

Report No.(s): DE2001-787180; SLAC-PUB-8796; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this note, we study a matrix-regularized version of non-commutative $U$ Chern-Simons theory proposed recently by Polychronakos. We determine a complete minimal of exact wavefunctions for the theory at arbitrary level $k$ and rank $N$ and show that these are in one-to-one correspondence with Laughlin-type wavefunctions describing excitations of a quantum Hall droplet composed of $N$ electrons at filling fraction 1/$k$. The finite matrix Chern-Simons theory is shown to be precisely equivalent to the theory of composite fermions in the lowest Landau level, believed to provide and accurate description of the filling fraction 1/$k$ fractional quantum Hall state. In the large $N$ limit, this implies that level $k$ noncommutative $U$ Chern-Simons theory is equivalent to the Laughlin theory of the lling fractions 1$k$ quantum Hall fluid, as conjectured recently by Susskind.

NTIS

*Hall Effect; Field Theory (Physics); Matrix Theory*

**20020017267** Stanford Linear Accelerator Center, CA USA

**Symmetry, or Lack of it, Between Matter and Antimatter**

Quinn, H. R.; Feb. 28, 2001; 27p; In English

Report No.(s): DE2001-787179; SLAC-PUB-8784; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The subject of antimatter and its relationship to matter began with Dirac, with the publication of his famous equation in 1928. Today it remains an active area of particle physics. The dominant issue for a number of major experimental programs is to decipher the nature of the difference in the laws of physics for matter and for antimatter. This has been a central issue of my work in the past few years, and a recurring theme in earlier work. Hence when I was asked to review a subject of my choice for this conference, this was the obvious choice for me; a very different focus from any other talk here. (Also, it allows me along the way make reference to both piece of work for which I was cited in my Dirac award, though neither is central to this story.) Given this opportunity, I decided to start with the early history of the subject, both in honor of Dirac and his essential role in it, and because it is fascinating to look back and see how understanding evolves.

NTIS

*Matter (Physics); Symmetry; Antimatter*

**20020017533** Fermi National Accelerator Lab., Batavia, IL USA

**U.S. Effort in Neutrino Factories**

Raja, R.; Aug. 16, 2001; 18p; In English

Report No.(s): DE2001-784420; FERMILAB-CONF-01/224-E; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We discuss the physics case for a neutrino factory and present the status of the export in the U.S in making the neutrino factory a reality. We present the results from the two feasibility studies done on the factory and describe the R&D activities in collecting, cooling and accelerating muons. A staged scenario in which a neutrino factory is realized step by step is presented.

NTIS

*Neutrinos; Industrial Plants*

**20020017933** Stanford Linear Accelerator Center, CA USA

**Application of Pauli-Villars Regularization and Discretized Light-Cone Quantization to a Single-Fermion Truncation of Yukawa Theory**

Brodsky, S. J.; Jul. 25, 2001; 28p; In English

Report No.(s): DE2001-787191; SLAC-PUB-8890; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We apply Pauli-Villars regularization and discrete light-cone quantization to the nonperturbative solution of (3+1)-dimensional Yukawa theory in a single-fermion truncation. Three heavy scalars, including two with negative norm, are used to regulate the theory. he matrix eigenvalue problem is solved for the lowest-mass state with use of a new, indefinite-metric Lanczos algorithm. Various observables are extracted from the wave functions, including average multiplicities and average momenta of constituents, structure functions, and a form factor slope.

NTIS

*Light-Cone Expansion; Fermions; Yukawa Potential*

**20020017937** Stanford Linear Accelerator Center, CA USA

**AdS Backgrounds from Asymmetric Orientifolds**

Silverstein, E. M.; Jul. 25, 2001; 13p; In English

Report No.(s): DE2001-787187; SLAC-PUB-8869; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

I present asymmetric orientifold models that, with the addition of RR fluxes, fix all the NS NS moduli including the dilaton. In critical string theory, this gives new AdS backgrounds with (discretely tunably) weak string coupling. Extrapolating to super-critical string theory, this construction leads to a promising candidate for a metastable de Sitter background with string coupling of order 1/10 and dS radius of order 100 times the string scale. Extrapolating further to large and large super-critical dimension suggests the possibility of finding de Sitter backgrounds with weaker and weaker string coupling. This note is an updated version of the last part of my Strings 2001 talk.

NTIS

*String Theory; Asymmetry*

**20020017938** Stanford Linear Accelerator Center, CA USA

**Generating Small Numbers by Tunneling in Multi-Throat Compactifications**

Silverstein, E. M.; Jul. 25, 2001; 55p; In English

Report No.(s): DE2001-787186; SLAC-PUB-8862; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A generic F-theory compactification containing many D3 branes develops multiple brane throats. The interaction of observers residing inside different throats involves tunneling suppression and, as a result, is very weak. This suggests a new mechanism for generating small numbers in Nature. One application is to the hierarchy problem: large supersymmetry breaking near the unification scale inside a shallow throat causes TeV-scale SUSY-breaking inside the standard-model throat. Another application, inspired by nuclear-decay, is in designing naturally long-lived particles: a cold dark matter particle residing near the standard model brane decays to an approximate CFT-state of a longer throat within a Hubble time. This suggests that most of the mass of the universe today could consist of CFT-matter and may soften structure formation at sub-galactic scales. The tunneling calculation demonstrates that the coupling between two throats is dominated by higher dimensional modes and consequently is much larger than a naive application of holography might suggest.

NTIS

*Supersymmetry; Resonant Tunneling*

**20020017997** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**DSP-Based Beam Current Monitoring System for Machine Protection Using Adaptive Filtering**

Musson, J.; Dong, H.; Flood, R.; Hovater, C.; Hereford, J.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783613; JLAB-ACE-01-01; DOE/ER/40150-1866; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The CEBAF (Continuous Electron Beam Accelerator Facility) accelerator at Jefferson Lab is currently using an analog beam current monitoring (BCM) system for its machine protection system (MPS), which has a loss accuracy of 2 micro-amps. Recent burn-through simulations predict catastrophic beam line component failures below 1 micro-amp of loss, resulting in a blind spot for the MPS. Revised MPS requirements target an ultimate beam loss accuracy of 250 nA. A new beam current monitoring system has been developed which utilizes modern digital receiver technology and digital signal processing concepts. The receiver employs a direct-digital down converter integrated circuit, mated with a Jefferson Lab digital signal processor VME card. Adaptive filtering is used to take advantage of current-dependent burn-through rates. Benefits of such a system include elimination of DC (direct current) offsets, generic algorithm development, extensive filter options, and interfaces to UNIX-based control systems.

NTIS

*Electron Beams; Linear Accelerators; Adaptive Filters; Signal Processing*

**20020018137** Thomas Jefferson National Accelerator Facility, Newport News, VA USA

**High Brightness Injectors Based On Photocathode DC Gun**

Yunn, B.; Jun. 01, 2001; 3p; In English

Report No.(s): DE2001-783625; JLAB-ACP-01-03; DOE/ER/40150-1877; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Sample results of new injector design method based on a photocathode dc (direct current) gun are presented, based on other work analytically proving the validity of the emittance compensation scheme for the case even when beam bunching is involved. We have designed several new injectors appropriate for different bunch charge ranges accordingly. Excellent beam quality

produced by these injectors clearly shows that a photocathode dc gun can compete with a rf gun on an equal footing as the source of an electron beam for the bunch charge ranging up to 2 nano Coulomb (nC). This work therefore elevates a dc gun based injector to the preferred choice for many ongoing high brightness accelerator projects considering the proven operational stability and high average power capability of the dc gun.
NTIS
*Electron Beams; Beam Injection; Electron Guns*

**20020018138** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Online Measurement and Tuning of Multipass Recirculation Time in the CEBAF Linac**
Tiefenback, M. G.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783621; JLAB-ACO-01-01; DOE/ER/40150-1874; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

CEBAF is a recirculating electron accelerator with negligible synchrotron motion of the particles within each bunch. On-crest RF (radio frequency) acceleration is used to minimize the time-averaged energy spread of the beam. Previously installed diagnostics allow us to maintain the relative timing of the beam and the RF, noninvasively compensating for residual drifts of the RF timing system on the first acceleration pass. However, residual setup errors for the path length (recirculation time) and variable path length drift between passes result in relative drifts of beam energy at the 10-4 scale for some passes, even when the energy of any one of the recirculation passes is held fixed by adjusting the RF gradient. We have extended the diagnostic system to the higher acceleration passes and can correct the recirculation timing at the scale of hundreds of femtoseconds (tenths of a degree of 1497 MHz RF phase). Variation in the higher-pass beam to RF timing indicates drift in the beam recirculation time. The previous procedure for measuring and tuning the path length required suspension of beam delivery to the users. These actions can now be done without interruption of beam to the experimenters.
NTIS
*Electron Accelerators; Tuning; Linear Accelerators*

**20020018141** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Design of the SNS Cryomodule**
Schneider, W.; Daly, E.; Hogan, J.; Hiatt, T.; Kneisel, P.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783617; JLAB-ACE-01-05; DOE/ER/40150-1870; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Plans are underway to develop a medium beta (0.61) and a high beta (0.81) cryomodule for the super-conducting portion of the Spallation Neutron Source (SNS). This paper describes the design of these cryomodules that provide a significant portion of the total acceleration to the proton beam. The design minimizes the effect of losses on cavity performance by preserving cavity cleanliness, maintaining high vacuum and shielding the cavity from the earth's magnetic field. A modal analysis was performed to maintain resonance by minimizing cavity microphonics and provide cavity tuning. The cryomodule design optimizes the cryostat heat load to the refrigerator on the primary (2 K), secondary (5 K) and shield (50 K) circuits and facilitates production of multiple modules (thirty-two maximum) at a reasonable cost. The paper describes the two types of cavities, the helium vessel, the tuner, the magnetic shields, the thermal shield, the power couplers, the space frame, the vacuum tank and the end cans that make up the medium and high beta cryomodules.
NTIS
*Superconducting Devices; Neutron Sources; Cryogenics; Spallation; Particle Acceleration*

**20020018142** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Cryogenic Testing of the RF Input Waveguide for the CEBAF Upgrade Cryomodule**
Breth, M.; Drury, M.; Getz, R.; Hiatt, T.; Phillips, L.; Jun. 01, 2001; 3p; In English
Report No.(s): DE2001-783616; JLAB-ACE-01-04; DOE/ER/40150-1869; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In order to support the planned CEBAF (Continuous Electron Beam Accelerator Facility) upgrade at the Jefferson Lab a new cryomodule has been designed. A key component of the new cryomodule is the upgraded RF (radio frequency) input waveguide, which may couple as much as 10 kW of Radio Frequency (RF) power to Superconducting Radio Frequency (SRF) cavities contained in a bath of superfluid helium. The coupler consists of a straight copper plated stainless steel waveguide as a thermal transition between 2K and 300K and one ceramic window at the warm end of the waveguide. The waveguide interior shares a common vacuum with the cavity. Initial testing of the upgraded coupler has been conducted at Jefferson Lab in a representative cryomodule. During testing, data was obtained regarding waveguide temperature profiles as well as coupler arcing and

multipacting. Predicted temperature profiles were used to determine the optimum location of the 50K heat intercept on the waveguide, and were found to be comparable to the actual measured profiles. The coupler was found to be free of multipacting up to 1.7 kW. No arcing occurred during multiple eight-hour runs in heavy field emission with typical radiation levels of 0.5 to 1.0 R/hr outside the cryostat.
NTIS
*Cryogenics; Waveguides; Linear Accelerators; Design Optimization; Radio Waves*

**20020018204** Stanford Linear Accelerator Center, CA USA
**Exact Solutions to Pauli-Villars-Regulated Field Theories**
Brodsky, S. J.; Jul. 27, 2001; 20p; In English
Report No.(s): DE2001-787198; SLAC-PUB-8920; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We present a new class of quantum field theories which are exactly solvable. The theories are generated by introducing Pauli-Villars fermionic and bosonic fields with masses degenerate with the physical positive metric fields. An algorithm is given to compute the spectrum and corresponding eigensolutions. We also give the operator solution for a particular case and use it to illustrate some of the tenets of light-cone quantization. Since the solutions of the solvable theory contain ghost quanta, these theories are unphysical. However, we also discuss how perturbation theory in the difference between the masses of the physical and Pauli-Villars particles can be developed, thus generating physical theories. The existence of explicit solutions of the solvable theory also allows one to study the relationship between the equal-time and light-cone vacua and eigensolutions.
NTIS
*Algorithms; Perturbation Theory; Quantum Theory; Quantum Mechanics; Elementary Particles*

**20020018205** Stanford Linear Accelerator Center, CA USA
**Stringy Quantum Hall Fluid**
Brodie, J. H.; Aug. 20, 2001; 24p; In English
Report No.(s): DE2001-787196; SLAC-PUB-8916; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Using branes in massive Type IIA string theory, and a novel decoupling limit, we provide an explicit correspondence between non-commutative Chern-Simons theory and the fractional quantum Hall fluid. The role of the electrons is played by D-particles, the background magnetic field corresponds to a RR2-form flux, and the two-dimensional fluid is described by non-commutative D2-branes. The filling fraction is given by the ratio of the number of D2-branes and the number of D8-branes, and therefore by the ratio rank/level of the Chern-Simons gauge theory. Quasiparticles and quasiholes are realized as endpoints of fundamental strings on the D2-branes, and are found to possess fractional D-particle charges and fractional statistics.
NTIS
*String Theory; Quantum Mechanics; Particle Theory; Quantum Hall Effect; Elementary Excitations*

**20020018206** Stanford Linear Accelerator Center, CA USA
**Domain Walls with Strings Attached**
Shmakova, M.; Aug. 20, 2001; 13p; In English
Report No.(s): DE2001-787195; SLAC-PUB-8915; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We have constructed a bulk & brane action of IIA theory which describes a pair of BPS domain walls on S1/Z2, with strings attached. The walls are given by two orientifold O8-planes with coincident D8-branes and 'F10D0'-strings are stretched between the walls. This static configuration satisfies all matching conditions for the string and domain wall sources and has 14 of unbroken supersymmetry.
NTIS
*Domain Wall; Supersymmetry; String Theory; Quantum Theory*

**20020018836** Stanford Linear Accelerator Center, CA USA
**Don't Panic. Closed String Tachyons in ALE Spacetimes**
Silverstein, E. M.; Aug. 20, 2001; 49p; In English
Report No.(s): DE2001-787217; SLAC-PUB-8955; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We consider closed string tachyons localized at the fixed points of noncompact non-supersymmetric orbifolds. We argue that tachyon condensation drives these orbifolds to flat space or supersymmetric ALE spaces. The decay proceeds via an expanding

shell of dilaton gradients and curvature that interpolates between two regions of distinct angular geometry. The string coupling remains weak throughout.
NTIS
*Tachyons; String Theory; Weak Interactions (Field Theory); Coupling*

## 80
## SOCIAL AND INFORMATION SCIENCES (GENERAL)

*Includes general research topics related to sociology; educational programs and curricula.*

**20020020171** NASA Marshall Space Flight Center, Huntsville, AL USA
**Lessons Learned and Technical Standards: A Logical Marriage**
Gill, Paul, NASA Marshall Space Flight Center, USA; Vaughan, William W., NASA Marshall Space Flight Center, USA; Garcia, Danny, NASA Marshall Space Flight Center, USA; [2001]; 8p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A comprehensive database of lessons learned that corresponds with relevant technical standards would be a boon to technical personnel and standards developers. The authors discuss the emergence of one such database within NASA, and show how and why the incorporation of lessons learned into technical standards databases can be an indispensable tool for government and industry. Passed down from parent to child, teacher to pupil, and from senior to junior employees, lessons learned have been the basis for our accomplishments throughout the ages. Government and industry, too, have long recognized the need to systematically document and utilize the knowledge gained from past experiences in order to avoid the repetition of failures and mishaps. The use of lessons learned is a principle component of any organizational culture committed to continuous improvement. They have formed the foundation for discoveries, inventions, improvements, textbooks, and technical standards. Technical standards are a very logical way to communicate these lessons. Using the time-honored tradition of passing on lessons learned while utilizing the newest in information technology, the National Aeronautics and Space Administration (NASA) has launched an intensive effort to link lessons learned with specific technical standards through various Internet databases. This article will discuss the importance of lessons learned to engineers, the difficulty in finding relevant lessons learned while engaged in an engineering project, and the new NASA project that can help alleviate this difficulty. The article will conclude with recommendations for more expanded cross-sectoral uses of lessons learned with reference to technical standards.
Author
*Information Systems; Education; NASA Programs*

## 81
## ADMINISTRATION AND MANAGEMENT

*Includes management planning and research.*

**20020017756** NASA Marshall Space Flight Center, Huntsville, AL USA
**The Impact of Organization Culture on Satisfaction of Engineers in Technology**
Westbrook, Jerry W., Alabama Univ., USA; Takada, Pamela W., NASA Marshall Space Flight Center, USA; [2001]; 7p; In English; ASEM 22nd National Conference, Engineering Management: It's About People, 11-13 Oct. 2001, Huntville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In today's technological workplace with the shortage of qualified knowledge workers, the factors that lead to job satisfaction have increasing importance. Several past studies have indicated that knowledge worker job satisfaction increases when Herzberg motivators are present. Other research has indicated that job satisfaction improves as the degree of organic organizational culture increases. After examining the factors that led to knowledge worker job satisfaction, the current study was undertaken. Knowledge workers in varying organizational cultures were surveyed in an effort to determine if there is a relationship between the degree of knowledge worker job satisfaction and the measure of organic organization culture. Two survey instruments, the Organizational Cultural Assessment (OCA) developed by Riegle, and the Minnesota Satisfaction Questionnaire (MSQ), were utilized. The OCA delineates degree of organic culture present whereas the MSQ measures job satisfaction. Results of both surveys were statistically analyzed to determine if knowledge workers experience higher satisfaction levels in organic organizational cultures. Once data was analyzed and the hypothesis proven, this could lead companies to move toward an organic culture with emphasis on motivators in an effort to make their organizational culture more conducive to higher employee retention. Through understanding the factors that lead to increased job satisfaction, corporate resources could more efficiently utilized. A total of eight high

technology workplaces were surveyed. Five of the eight workplaces yielded statistically significant positive correlation between a positive organizational culture and increased job satisfaction. These initial results indicate the connection between culture and job satisfaction. The relationship will be further analyzed through future surveys of numerous high technology workplaces.
Author
*Organizations; Management Analysis; Personnel; Qualifications; Quality*

**20020017757** NASA Marshall Space Flight Center, Huntsville, AL USA
**NASA's Lessons Learned and Technical Standards: A Logical Marriage**
Gill, Paul, NASA Marshall Space Flight Center, USA; Vaughan, William W., NASA Marshall Space Flight Center, USA; Garcia, Danny, NASA Marshall Space Flight Center, USA; Weinstein, Richard, NASA Marshall Space Flight Center, USA; [2001]; 4p; In English; National Space and Missiles Materials Symposium, 25-28 Jun. 2001, Monterey, CA, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Lessons Learned have been the basis for our accomplishments throughout the ages. They have been passed down from father to son, mother to daughter, teacher to pupil, and older to younger worker. Lessons Learned have also been the basis for NASA's accomplishments for more than forty years. Both government and industry have long recognized the need to systematically document and utilize the knowledge gained from past experiences in order to avoid the repetition of failures and mishaps. Lessons Learned have formed the foundation for discoveries, inventions, improvements, textbooks, and Technical Standards.
Derived from text
*Education; NASA Programs; Data Bases; Systems Engineering*

**20020018190** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Managing Programmatic Risk for Complex Space System Developments**
Panetta, Peter V., NASA Goddard Space Flight Center, USA; Hastings, Daniel, Massachusetts Inst. of Tech., USA; [2001]; 10p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Risk management strategies have become a recent important research topic to many aerospace organizations as they prepare to develop the revolutionary complex space systems of the future. Future multi-disciplinary complex space systems will make it absolutely essential for organizations to practice a rigorous, comprehensive risk management process, emphasizing thorough systems engineering principles to succeed. Project managers must possess strong leadership skills to direct high quality, cross-disciplinary teams for successfully developing revolutionary space systems that are ever increasing in complexity. Proactive efforts to reduce or eliminate risk throughout a project's lifecycle ideally must be practiced by all technical members in the organization. This paper discusses some of the risk management perspectives that were collected from senior managers and project managers of aerospace and aeronautical organizations by the use of interviews and surveys. Some of the programmatic risks which drive the success or failure of projects are revealed. Key findings lead to a number of insights for organizations to consider for proactively approaching the risks which face current and future complex space systems projects.
Author
*Complex Systems; Management Systems; Organizations; Risk*

**20020018609** Federal Aviation Administration, Washington, DC USA
**FAA Fiscal Year 2000 Annual Performance Plan**
Dec. 2000; 60p; In English; Original contains color images
Report No.(s): AD-A397023; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Federal Aviation Administration s (FAA) FY 2000 Annual Performance Plan represents the agency s commitment to managing for results. The annual performance plan supplements the strategic plan and sets goals with measurable target levels of performance. It is the basis for developing annual program performance reports that will compare actual performance to the goals. The FAA submits its FY 2000 Annual Performance Plan in support of the FY 2000 budget request.
DTIC
*Planning; Federal Budgets; Goals; Management Systems; Control*

## 82
## DOCUMENTATION AND INFORMATION SCIENCE

*Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.*

**20020016118** General Accounting Office, Washington, DC USA
**Information Security Risk Assessment: Practices of Leading Organizations: A Supplement to GAO's May 1998 Executive Guide to Information Security Management**
Nov. 1999; 51p; In English; Original contains color images
Report No.(s): AD-A396615; GAO/AIMD-00-33; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy
This guide is intended to help federal managers implement an ongoing information security risk assessment process by providing examples, or case studies, of practical risk assessment procedures that have been successfully adopted by four organizations known for their efforts to implement good risk assessment practices. More importantly, it identifies, based on the case studies, factors that are important to the success of any risk assessment program, regardless of the specific methodology employed.
DTIC
*Assessments; Information Management; Risk; Computer Information Security*

**20020016252** Richland Operations Office (AEC), WA USA
**Environmental Information Systems HWIS and HEIS Web Application Detailed Design Specification**
Caldwell, J. S.; Oct. 01, 2001; 68p; In English
Report No.(s): DE2001-787963; BHI-01578; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The main intent of this document is to provide detailed design information about the Hanford Well Information System and Hanford Environmental Information System web application development
NTIS
*Information Systems; World Wide Web; Environmental Surveys*

**20020016258** Richland Operations Office (AEC), WA USA
**Environmental Information Systems HWIS and HEIS Web Application Conversion Project Plan**
Caldwell, J. S.; Oct. 01, 2001; 20p; In English
Report No.(s): DE2001-787962; BHI-01577; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The main intent of this document is to provide information about HWIS and HEIS Web application development, including deliverables, schedules, risks, dependencies, assumptions, estimates, and members of the project team.
NTIS
*Information Systems; World Wide Web; Environmental Surveys; Project Planning*

**20020016259** Richland Operations Office (AEC), WA USA
**Virtual Library Effluent Volume to Soil Disposal Sites Module Specification**
deLamare, M. A.; Sep. 27, 2001; 28p; In English
Report No.(s): DE2001-787933; BHI-01572; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This document provides the design specifications for each of the modules identified in the Virtual Library. The design specifications include design logic, input and output specifications, validation, and error handling.
NTIS
*Libraries; Specifications; Soils; Modules*

**20020016260** Richland Operations Office (AEC), WA USA
**Virtual Library Maintenance Plan**
deLamare, M. A.; Sep. 27, 2001; 31p; In English
Report No.(s): DE2001-787932; BHI-01569; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This document establishes the methods used by the Environmental Restoration Contractor to maintain the Virtual Library. The methods identified are for user, data, and system management.
NTIS
*Libraries; Maintenance; Data Systems*

**20020016271** General Accounting Office, Accounting and Information Management Div., Washington, DC USA
**Executive Guide: Information Security Management. Learning From Leading Organizations**
May 1998; 70p; In English
Report No.(s): AD-A396598; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Increased computer interconnectivity and the popularity of the Internet are offering organizations of all types unprecedented opportunities to improve operations by reducing paper processing, cutting costs, and sharing information. However, the success of many of these efforts depends, in part, on an organization's ability to protect the integrity, confidentiality, and availability of the data and systems it relies on. Deficiencies in federal information security are a growing concern. In a February 1997 series of reports to the Congress, GAO (General Accounting Office) designated information security as a government-wide high risk area. In October 1997, the President's Commission on Critical Infrastructure Protection described the potentially devastating implications of poor information security from a broader perspective in its report entitled Critical Foundations: Protecting America's Infrastructures. Since then, audit reports have continued to identify widespread information security weaknesses that place critical federal operations and assets at risk. This guide is one of a series of GAO publications that are intended to define actions federal officials can take to better manage their information resources,
DTIC
*Computer Information Security; Information Management; Computer Networks*

**20020016303** Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
**Development of the Rocket Motor Electronic Database (RMED)**
Moore, Thomas L., Johns Hopkins Univ., USA; 50th JANNAF Propulsion Meeting; July 2001; Volume 1, pp. 57-68; In English; Also announced as 20020016300; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Advances in personal computing power and relational database technology provided a compelling impetus for CPIA to migrate the wealth of data contained in its Rocket Motor Manual and related sources into compact electronic form. A recent software development effort by CPIA has culminated in the initial release of the Rocket Motor Electronic Database (RMED). RMED is a highly functional and versatile tool used for rapidly locating technical reference data on solid propellant rocket motors and gas generators used for rockets, missiles, launch vehicles, orbit transfer, jet-assist take-off, ejection devices, and test vehicles. RMED's software development effort and its features, capabilities, and future plans are described.
Author
*Solid Propellant Rocket Engines; Relational Data Bases; Computer Programming; Software Engineering; Launch Vehicles*

**20020016329** Research and Technology Organization, Information Systems Technology Panel, Neuilly-sur-Seine, France
**Information Management Challenges in Achieving Coalition Interoperability** ***Les Defis de la Gestion de l'Information dans la Mise en Oeuvre de l'Interoperabilite au Sein d'une Coalition***
December 2001; 302p; In English, 28-30 May 2001, Quebec, Canada; Also announced as 20020016330 through 20020016354; CD-ROM contains full text document in PDF and PowerPoint format
Report No.(s): RTO-MP-064; AC/323(IST-022)TP/11; ISBN 92-837-1078-9; Copyright Waived; Avail: CASI; C01, CD-ROM; A14, Hardcopy; A03, Microfiche

Increasingly, sensor Unmanned Aerial Vehicles (UAV) are utilized to gather intelligence data, and combat UAVs are being proposed as complementing manned aircraft. In addition, alternative operations concepts are being proposed for the cooperative use of manned and unmanned aerial vehicles. The workshop achieved its objectives of identify requirements and technical issues. It defined and, to some extent prioritized, key areas to be addressed by the follow-on RTO (Research and Technology Organization) SCI-124 Task Group on the same subject. It established the need for architectures that enable interoperability in NATO (North Atlantic Treaty Organization) mixed manned and unmanned air operations, as current approaches were unlikely to accomplish this task well. This would allow better battle management and C4ISR, as well as the basis for dynamic planning, monitoring and intervention. The workshop highlighted the need to define the concept of operations, including rules of engagement and command and control hierarchy, before defining architectures.
Author
*Pilotless Aircraft; Information Management; Conferences; Military Operations; Armed Forces*

**20020016330** Dalhousie Univ., Global Information Networking Inst., Halifax, Nova Scotia Canada
**Planning for Interoperability**
Gentleman, W. Morven, Dalhousie Univ., Canada; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 1-1 - 1-9; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Interoperability is a major concern for NATO (North Atlantic Treaty Organization). In addition to the focus of this meeting, on facilitating coalition operations, interoperability is crucial to several other themes of research undertaken by the IST (Information Systems Technology) Panel, such as use of COTS (commercial off-the-shelf) products in larger systems or following an Evolutionary Software Development process. In coalitions, the C2 (command and control) systems of one nation may want to take advantage of information and services available from the systems of other nations, correspondingly they may want to make available information and services to the systems of other nations. The challenge is that because of the independent development, these exchanges may not fit directly, but must accommodate the different perspectives that have been taken on the abstractions they represent in the different systems.
Author
*Information Systems; Interoperability; North Atlantic Treaty Organization (NATO); International Cooperation*

**20020016331** Defence Scientific Technology Lab., Integrated Systems Sector, Malvern, UK
**Standard or Standards? Some Issues to Consider in the Use of Meta-Data for Coalition Operations**
Miles, Jonathan, Defence Scientific Technology Lab., UK; Braim, Stephen, Defence Scientific Technology Lab., UK; Furze, Richard, Defence Evaluation Research Agency, UK; Peck, Mathew, Defence Evaluation Research Agency, UK; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 2-1 - 2-27; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper discusses the issues that need to be addressed to allow the unambiguous exchange of information between coalition forces during multi-national operations. It analyzes the problems caused by a lack of common meta-data vocabulary between nations. The paper considers current initiatives to define meta-data standards within the UK, and describes a putative approach to yield inter-government interoperability. It then extends the work undertaken within UK and considers its potential to provide interoperability between nations operating within a coalition. Centralized, Decentralized and Federated approaches to meta-data interoperability are described and issues associated with each approach are highlighted. The Federated approach, consisting of a common core supplemented by local meta-data sets, appears to offer the best conceptual solution to coalition interoperability as it offers a common naming scheme tag set which provides additional extensibility and will allow for an interface to existing national naming scheme initiatives. This will provide a degree of centralized control with flexibility for individual organizational unit needs.
Author
*Interoperability; Information Systems; International Cooperation; Information Transfer; Standards*

**20020016332** Cigital, Inc., Dulles, VA USA
**Commercial Off-the-Shelf Software Component Interoperability**
Voas, Jeffrey, Cigital, Inc., USA; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 3-1 - 3-4; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

When a software system fails, a confusing and complex liability problem ensues for all parties that have contributed software functionality (whether COTS (commercial off-the-shelf) or custom) to the system. Potential contributors to the system failure include: (1) defective software components, (2) problems with interfaces between components, (3) problems with assumptions (contractual requirements) between components, and (4) hidden interfaces and non-functional component behaviors that cannot be detected at the component level. In this paper, our goal is to focus on the interoperability problems created by defective COTS software components, and in particular, hidden interfaces and non-functional component behaviors. and we will also briefly look into the problem of how to compose one particular type of non-functional behavior, the 'ilities'.
Author
*Commercial Off-The-Shelf Products; Computer Programs; Interoperability; System Failures; Computer Systems Design*

**20020016333** SPOTI, Issy- les- Moulineaux, France
**Formal Approach of the Interoperability of C4IRS Operating within a Coalition** ***Approche Formelle de l'Interoperabilite de Systemes Entrant dans une Coalition***
Bares, Michel, SPOTI, France; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 4-1 - 4-13; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Coalitions between nations are formed to face either a crisis or emerging minor conflicts. These coalitions are formed for the purpose of increasing efficiency, by the coordinated action of military means and the gathering of their related technical systems, for instance: networks, C4IRS (Command and Control, Communications, Computers, Intelligence, Reconnaissance, and Surveillance). In merging these systems, we have to cope with a major problem, which is to have heterogeneous systems intercooperate. The verb intercooperate is intentionally used to highlight the new needs differing completely from the simple

exchange messages. The heterogeneity of these systems, inherent to national design and applications concepts, generates big deficiencies at the interoperability level. Since the solution of making gangways is not easily and reasonably generalized, the right thing to do is to provide all systems entering in a coalition with interoperability mechanisms. In this paper, we propose a formal approach which is relying on three main concepts: openness structure for a coalition, interoperability space with the definition of an interoperability matrix, intercooperability domain in which we are able to define parameters that allow us to assess interoperability from different points of view.
Author
*Interoperability; International Cooperation; Information Systems; Computer Systems Design; Information Transfer*

**20020016334** Defence Research Establishment Valcartier, Val Belair, Quebec Canada
**UML Modeling Rules for Interoperable Architecture Artifacts**
Lizotte, Michel, Defence Research Establishment Valcartier, Canada; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 6-1 - 6-14; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In recent years, time required to develop software interoperability solutions has become a key factor in the success of coalition operations. This paper introduces a set of Modeling Rules refining and restricting the Unified Modeling Language (UML) usage to a minimal set of models. Such an approach reduces precious time of software architects to get the right information and to understand the real issues of the problem. It enables navigation into software models from high-level artifacts down to the required level of detail using an object and behavior perspective.
Author
*Interoperability; International Cooperation; Computer Programming; Software Development Tools*

**20020016335** Forschungsgesellschaft fuer Angewandte Naturwissenschaften e.V, Research Inst. for Communication, Information and Ergonomics, Wachtberg-Werthhoven, Germany
**Modelling Command and Control Information Systems by UML**
Fassbender, Heinz, Forschungsgesellschaft fuer Angewandte Naturwissenschaften e.V, Germany; Buehler, Gerhard, Forschungsgesellschaft fuer Angewandte Naturwissenschaften e.V, Germany; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 7-1 - 7-9; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The complexity of command and control information systems is increasing continuously. The result of the augmentation of their interoperability to systems of own troops or foreign nations raises the difficulty for administration and maintenance. A possible approach to manage this problem is the use of a visual modelling annotation. It helps to manage the complex structures of command and control information systems. In the context of information modelling, the data model which is represented as an entity relationship diagram, has become a standard. This is a first step of the abstraction from the source code. But to give a complete survey, the design of the complete system has to be modelled. In former times when the structured style of programming was used, the architectures of programs were modelled by structured design techniques. In the last decade structured programming has been more and more replaced by object oriented programming. This leads to the definition of many object oriented analysis and design methods which are unified in the unified modelling language (UML). UML now is the standard for modelling object oriented information systems. In particular, UML offers an annotation for modelling interfaces. Hence, it seems to be the most promising candidate for modelling command and control information systems which should be interoperable. In this paper we illustrate how we model the existing experimental integration platform for command and control information systems. INFIS which has been developed in our institute and which serves as the German testbed for interoperability tests in the ATCCIS study and the Multilateral Interoperability Programme (MIP), by UML. That means, this paper will not include a description of modeling the different phases in the development of a new command and control information system. It describes how to model an existing command and control information system. The paper is structured as follows. In Section 2, the global structure of INFIS is modeled by a self-defined annotation and the usage of UML will be motivated. We present our UML modeling process for INFIS in Section 3. This process determines the structure of the following sections. Modeling INFIS high-level structure, its low-level structure, and their combination will be described in Sections 4, 5, and 6, respectively. We finish the UML-modelling process of INFIS by presenting a dynamic model that illustrates the interactions between INFIS objects for computing an application.
Author
*Interoperability; Information Systems; Dynamic Models; Command and Control; International Cooperation; Programming Languages; Computer Systems Design*

**20020016336** Forschungsgesellschaft fuer Angewandte Naturwissenschaften e.V, FKIE, Wachtberg-Werthhoven, Germany

**Natural Language Access for C4I Systems**

Hecking, Matthias, Forschungsgesellschaft fuer Angewandte Naturwissenschaften e.V, Germany; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 8-1 - 8-8; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

There is no precise meaning of the term 'interoperability'. In the proceedings of the conference Multi-Lingual Interoperability in Speech Technology, the term is further specified. Interoperability includes aspects between systems, between people, between people and systems, and for different tasks. In this paper we deal with the aspect of interoperability between people and systems. The basic message is that the use of human language can improve the cooperation between people and systems. But there is another aspect of using human language in human-computer interaction. New military NATO (North Atlantic Treaty Organization) operations and growing coalitions demand for more complex C4I (Command, Control, Communications, Computers and Intelligence) systems. The development cycles of these systems are becoming shorter. This also means, that the users will have less time to learn how to use these systems. A natural way to communicate is to use natural language. If the C4I systems would have the ability to process spoken language, this would reduce the training curve for new systems and would simplify the usage of the systems. Today, the usability of human language technology (HLT) is restricted to narrow and well defined application areas (domains). Another requirement is that the language must be restricted as well. This means, that the vocabulary and the grammatical structures must be limited enough such that processing time becomes acceptable. The military domain and the stereotyped military command language seem to be appropriated for using HLT. In our project NATLAC (natural language access) we try to show that the available methods, techniques, and tools of computational linguistics are mature enough to look whether they are applicable to C4I systems for different purposes. Especially, the scientific progress in the field of speech recognition is promising. In this paper, we will present the project NATLAC in more detail in section four and we will report about our experiences gained in the use of the speech recognizer. Prior in section two we give a short overview of the available information concerning military use of HLT and we mention those projects that use human language in C4I related areas. In section three possible applications of HLT in C4I systems are described.

Author

*Command and Control; Computers; Human-Computer Interface; Interoperability; Natural Language (Computers)*

**20020016337** Defence Research Establishment Valcartier, Decision Support Technology Section, Val Belair, Quebec Canada

**Ontologies for Coalition Interoperability**

Boury-Brisset, Anne-Claire, Defence Research Establishment Valcartier, Canada; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 9-1 - 9-10; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Future command and control information systems will have to take into account interoperability issues so that information can be effectively shared and exploited within coalition operations. In this context, interactions between participants require mechanisms to facilitate the exchange of information and provide a shared understanding of the situation based at least on a commonly agreed terminology. One solution to facilitate the communication between agents is to build a common ontology that represents a shared model of a domain. In this paper, we show the role of ontologies in coalition environments, we present methods and tools for collaborative ontology construction and describe how ontologies can facilitate interoperability between heterogeneous information sources.

Author

*Command and Control; Information Systems; Interoperability*

**20020016338** Competence Center Informatik G.mb.H., Meppen, Germany

**Data Management for Coalition Interoperability**

Kuees, Bernhard, Competence Center Informatik G.mb.H., Germany; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 10-1 - 10-6; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Internationally agreed standard data definitions are crucial for coalition interoperability between C4I (Command, Control, Communication, Computers, and Intelligence) systems. A new standard data model for NATO (North Atlantic Treaty Organization) consultation, command, and control (C3) is the NATO Corporate Data Model. It comprises a collection of various data models including one generic reference data model used as its joint conceptual core. The NATO Corporate Data Model and all related administrative information are available in the NATO C3 Repository, a data dictionary and administration tool to support data management within NATO. In addition to this data dictionary support, a hierarchical structure with organizational

interfaces between national and international data management authorities will be necessary in order to achieve a well-performing data management in the multinational community of NATO.
Author
*Interoperability; Command and Control; Computers; Intelligence; Telecommunication; Data Management*

**20020016339** Zayed Univ., Coll. of Information Systems, Dubai, United Arab Emirates
**An Agent-Based Approach to Achieve Interoperable and Adaptable Military Coalitions**
Maamar, Zakaria, Zayed Univ., United Arab Emirates; Sahli, Nabil, Laval Univ., Canada; Moulin, Bernard, Laval Univ., Canada; Labbe, Paul, Defence Research Establishment Valcartier, Canada; Demers, David, Defence Research Establishment Valcartier, Canada; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 11-1 - 11-10; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Military coalitions not only exploit complex information technologies but also must be able to adapt to changing international and departmental agreements, operational procedures, and new technology insertion. A software agent is an autonomous entity that is able to carry out complex operations on behalf of users. In addition, a mobile agent is able to move from machine to machine, performing its operations locally. This paper discusses how software agents could be used to aid the interoperability and adaptability of military coalitions. Defining, managing, and adapting these coalitions' processes by way of agents is also discussed.
Author
*Computer Programs; Interoperability; International Cooperation; Armed Forces*

**20020016345** Assistant Secretary of Defense (Research and Strategic Planning), Washington, DC USA
**Key Concepts for Information Superiority**
Alberts, David S., Assistant Secretary of Defense (Research and Strategic Planning), USA; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 18-1 - 18-23; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Information Superiority is on the critical path of our journey to the future. This paper explains why this is so and identifies a number of specific actions that are necessary to facilitate our journey and to expedite progress toward our goal.
Author
*Information Systems; Defense Program; USA*

**20020016349** North Atlantic Treaty Organization, The Hague, Netherlands
**Data-Translation: Leveraging Legacy Data for NATO**
Krick, Martin R., North Atlantic Treaty Organization, Netherlands; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 22-1 - 22-5; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

This paper describes an ongoing effort at NC3A (NATO (North Atlantic Treaty Organization) Command, Control, and Communication Agency) to provide one integrated database which contains data from a number of different sources. Initially, these sources are legacy NATO systems. Later, other systems, including messaging interfaces of a wide variety, and national systems, will be added. A common data model is used as the lingua franca between systems. A COTS (commercial off the shelf) product has been identified that creates translator boxes to provide interfaces to and from the legacy systems.
Author
*Data Bases; North Atlantic Treaty Organization (NATO); Data Base Management Systems; Translating; Data Transfer (Computers); Interoperability*

**20020016351** Ministry of Defence, London, UK
**Data Fusion and the Coalition Common Operating Picture**
Stewart, James, Ministry of Defence, UK; Pierre, Leslie, Ballistic Missile Defense Organization, USA; James, Paul, Defence Scientific Technology Lab., UK; Collinson, Alan, Collinson Systems Ltd., UK; Shand, Brian, Advanced System Architectures Ltd., UK; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 24-1 - 24-7; In English; Also announced as 20020016329; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

BMDO (Ballistic Missile Defense Organization) and the UK (UK) Defense Evaluation and Research Agency (DERA) under the direction of the MOD (Ministry of Defense) DSc (Directorate of Science) (BMD) have undertaken a series of technical demonstrations to investigate data fusion applied to development of an operational picture. BMDO and MoD DSc(BMD) are concerned with the development of ballistic missile technology. However, ballistic missiles are only part of the threat in theater.

The aim must be to integrate BMD into theater defense and use the common infrastructure. Hence, despite the focus on BMD, the work described has been undertaken in both ballistic targets and air breathing threat environments. Some further work is already being planned to be carried out later this year at Joint Exercise Roving Sands. This presentation describes the scope of the work undertaken and presents some of the most interesting results.
Author
*Multisensor Fusion; Military Operations; Ballistic Missiles; International Cooperation*

**20020016353** Physics and Electronics Lab. TNO, The Hague, Netherlands
**Information Interoperability and Information Standardisation for NATO C2: A Practical Approach**
Lasschuyt, Eddie, Physics and Electronics Lab. TNO, Netherlands; vanHekken, Marcel, Physics and Electronics Lab. TNO, Netherlands; Information Management Challenges in Achieving Coalition Interoperability; December 2001, pp. 5-1 - 5-20; In English; Also announced as 20020016329; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This article discusses a general and practical approach to reach interoperability among a large number of information systems of different natures. It is focused on the subject of information standardization, for the purpose of gaining interoperable systems. Based upon this approach, a number of considerations and recommendations are given for interoperability within the NATO (North Atlantic Treaty Organization) C2 (Command and Control) domain, i.e. between NATO C4I (Command, Control, Communications, Computers, and Intelligence) systems. The article is primarily intended to give an overview of this problem area and to make the reader aware of its significance and difficulty. It could make him/her realize that information standards deserve more attention in his/her community (e.g. a policy division, Defense research lab or C4I-related working group) and it may trigger him/her to give more thoughts on the matter. We must emphasize, though, that some issues in this article are not (yet) fully crystallized or haven't proven their value in practice (yet). Further discussion on these issues in international forums is strongly suggested. In chapter 2 we start with a general introduction to interoperability, hereby setting the technical scope for this article. Chapter 3 defines the problem we want to solve. It does so in terms of possible interoperability architectures and factors that influence the choice. The theory of chapter 3 is applied in practice, on the NATO C2 domain, in chapter 4. Suggestions are given for improving the NATO standardization efforts. Finally, chapter 5 summarizes the conclusions made in the other chapters domain, i.e. between NATO C4I systems. The article is primarily intended to give an overview of this problem area and to make the reader aware of its significance and difficulty.
Author
*Command and Control; Information Systems; Interoperability; Standardization; International Cooperation*

**20020016415** Thomas Jefferson National Accelerator Facility, Newport News, VA USA
**Jefferson Lab Mass Storage and File Replication Services**
Bird, I.; Chen, Y.; Hess, B.; Kowalski, A.; Watson, C.; Jul. 01, 2001; 4p; In English
Report No.(s): DE2001-783801; JLAB-PHY-01-17; DOE/ER/40150-1892; No Copyright; Avail: Department of Energy Information Bridge

Jefferson Lab has implemented a scalable, distributed, high performance mass storage system - JASMine. The system is entirely implemented in Java, provides access to robotic tape storage and includes disk cache and stage manager components. The disk manager subsystem may be used independently to manage stand-alone disk pools. The system includes a scheduler to provide policy-based access to the storage systems. Security is provided by pluggable authentication modules and is implemented at the network socket level. The tape and disk cache systems have well defined interfaces in order to provide integration with grid-based services. The system is in production and being used to archive 1 TB per day from the experiments, and currently moves over 2 TB per day total. This paper will describe the architecture of JASMine; discuss the rationale for building the system, and present a transparent 3rd party file replication service to move data to collaborating institutes using JASMine, XM L, and servlet technology interfacing to grid-based file transfer mechanisms.
NTIS
*Information Systems; Linear Accelerators*

**20020016723** NASA Marshall Space Flight Center, Huntsville, AL USA
**Configuration and Data Management Process and the System Safety Professional**
Shivers, Charles Herbert, NASA Marshall Space Flight Center, USA; [2001]; 7p; In English; 19th International System Safety Conference, 10-14 Sep. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This article presents a discussion of the configuration management (CM) and the Data Management (DM) functions and provides a perspective of the importance of configuration and data management processes to the success of system safety

activities. The article addresses the basic requirements of configuration and data management generally based on NASA configuration and data management policies and practices, although the concepts are likely to represent processes of any public or private organization's well-designed configuration and data management program.
Author
*Configuration Management; Data Management; Management Systems; Safety Factors*

**20020017468** Wichita State Univ., NAtional Inst. for Aviation Research, Wichita, KS USA
**Human Factors Survey of Aviation Technical Manuals Phase 1: Manual Development Procedures** ***Interim Report, 1 Jul. 00 - 11 Jan. 01***
Chaparro, A.; Croff, L. S.; Aug. 2001; 42p; In English
Report No.(s): PB2001-108481; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report contains the results from Phase 1 of a three-phase research effort. Phase 1 examines aviation industry procedures for developing maintenance technical data. Phase 2 will document user problems with maintenance technical data. Phase 3 will identify maintenance data development improvements by applying human factor principles. Five aircraft manufacturers were surveyed regarding company policy, communication, data tracking, user feedback, and error reduction efforts. The five industry participants represent both regional and large commercial transport manufacturers. Phase 1 survey results revealed three significant maintenance technical data issues: inconsistent development process guidelines, reactive rather than proactive response to user feedback, and inadequate assessment of errors involved usability as opposed to accuracy. Phase 1 results will later be compared to Phase 2 surveys of user problems with maintenance technical data to identify the impact of development procedures on the users perception of manual quality.
NTIS
*Aircraft Industry; Human Factors Engineering; User Manuals (Computer Programs)*

**20020018178** Richland Operations Office (AEC), WA USA
**Virtual Library Environmental Monitoring Module Specification**
deLamare, M. A.; Sep. 20, 2001; 76p; In English
Report No.(s): DE2001-787582; BHI-01538; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This document provides the design specifications for the environmental monitoring module identified in the Virtual Library user layer.
NTIS
*Environmental Monitoring; Libraries; Specifications*

**20020018179** Richland Operations Office (AEC), WA USA
**Virtual Library Software Requirements Specification**
deLamare, M. A.; Sep. 20, 2001; 44p; In English
Report No.(s): DE2001-787581; BHI-01537; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This document provides the design specifications for each of the modules identified in the Virtual Library user and administrative layers.
NTIS
*Computer Programs; Specifications; Information Systems*

**20020018830** Transportoekonomisk Inst., Oslo, Norway
**Electronic Commerce: A Need for New Solutions for Distribution and Warehousing** ***Elektronisk Handel: Behov for Nye Distribusjons- og Lagerlosninger***
Skyberg, T. E.; May 2000; 46p; In Norwegian
Report No.(s): PB2002-100788; TOI-1163/2000; Copyright; Avail: National Technical Information Service (NTIS)
The report summarizes the findings from an analysis of the effects that e-commerce will have on warehousing and distribution solutions. The analysis is based on available literature. E-commerce will lead to significant changes in the physical distribution of cargo, where both warehousing and distribution systems will be affected. Today's systems are important bottlenecks for future growth in e-commerce. If e-commerce is to be established as an important sales channel, it is substantial that effective solutions for warehousing and distribution are implemented.
NTIS
*Electronic Commerce; Materials Handling*

**20020018867** Physics and Electronics Lab. TNO, The Hague, Netherlands

**Knowledge@Work.KL: Ideas for an ERP Knowledge Structure** ***Final Report Knowledge@Work.KL: Inventarisatie van Ideeen voor enn Kennisstructuur ten Behoeve van ERP***

Nieuwenhuijs, I. A. H., Physics and Electronics Lab. TNO, Netherlands; Rademaker, J. G. M., MTL, Netherlands; Wagenaar, W. J. G. P., Physics and Electronics Lab. TNO, Netherlands; September 2001; 102p; In Dutch; Original contains color illustrations

Contract(s)/Grant(s): TNO Proj. 29566

Report No.(s): TD-2000-445; FEL-01-A114; Copyright; Avail: Issuing Activity

Knowledge is a fundamental resource for organizations in achieving their goals. ERP (Enterprise Resource Planning) implementations in the NL (Netherlands) Army ask for considerably extra knowledge. Knowledge structures to facilitate these implementations will enforce optimal use of this knowledge. In this study, a qualitative assessment of the knowledge domains to support an ERP implementation was done and existing knowledge gaps were identified. Furthermore, tools, a general roadmap and information are given upon which a design of a knowledge structure can be based.

Author

*Organizations; Knowledge Based Systems; Information Resources Management*

**20020018907** Southern Univ., Baton Rouge, LA USA

**Accessibility of NASA Wisdom**

Dyer, John, Southern Univ., USA; Moreman, Douglas, Southern Univ., USA; Coffee, John, Southern Univ., USA; HBCUs/OMUs Research Conference Agenda and Abstracts; November 2001, pp. 34; In English; Also announced as 20020018881

Report No.(s): P26; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Our pursuit of knowledge to preserve has led to a number of retired GRC and Pratt engineers and to Lockheed Martin, Pratt & Whitney, and Boeing personnel. Information in text, audio and video formats has been stored and methods of presenting it in weblike format have been demonstrated. We have gathered from retirees at GRC, knowledge about the causes of launch vehicle failures. Recently through a grant from Marshall Space Flight Center, we have begun to put online several thousand failure analysis reports generated over the last 40 years. Southern University is responsible for incorporating full reports with images, and providing search capabilities. There is no need for commercial database software since a web browser already provides the ability to select text, images, audio, and video for display. We can fine tune the file structure and links and search criteria to the needs of the launch vehicle and propulsion specialists. We have ambitious plans to identify the subdisciplines within rocket propulsion in large bodies of text. A user should be able to specify a few keywords so that the system can identify documents likely to match the user's interest. Our motivation has been, mainly, to preserve rare knowledge of senior engineers who are near retirement. Historical value of such knowledge, and also of our tools, has been pointed out to us by historians. We now propose the application of these tools to enhancing communication among groups that are working jointly on a project.

Author

*Information Resources Management; Launch Vehicles; Propulsion; Failure Analysis*

**20020019005** Air Univ., Maxwell AFB, AL USA

**Information Operations: America's Plan for Strategic Failure**

Lindner, Blake F.; Apr. 1998; 47p; In English

Report No.(s): AD-A397080; AU/AWC/161/1998-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper highlights problems with America's approach to information operations. These are the military's operational-level fixation and the government's fragmented approach to information operations. The paper recommends leaders fully accept the strategic value of information, include information as an instrument of national power, and broaden the defensive approach of the President's Commission on Critical infrastructure Protection to include proactive measures.

DTIC

*Military Operations; Information Systems*

**20020019409** General Accounting Office, Washington, DC USA

**2000 CENSUS: Significant Increase in Cost Per Housing Unit Compared to 1990 Census**

Miller, Dan; Clay, William L., Jr.; Dec. 2001; 27p; In English

Report No.(s): AD-A397207; GAO-02-31; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The decennial census is the nation's most comprehensive and expensive data-gathering program. From providing the basis for apportioning the U.S. House of Representatives to providing data used by communities, businesses, and Americans everywhere, the decennial census provides a great deal of knowledge about our nation. In a previous report,' we estimated that when compared to the 1970 census, the projected full-cycle cost per housing unit of the 2000 census would quadruple and the total

cost would nearly double the costs of the 1990 census. According to Census officials, the significant cost increase can be attributed primarily to the bureau's attempt to achieve a better quality census than in 1990. According to preliminary data from the Accuracy and Coverage Evaluation program, it appears that the 2000 census did reduce the net undercount for children and minorities compared to the 1990 census. However, due to current, ongoing studies and evaluations of the 2000 census, it is too early to determine the full extent of improvements compared to the 1990 census.
DTIC
*Census; Residential Areas; Minorities; Costs*

**20020020452** Naval Postgraduate School, Monterey, CA USA
**Information Systems Strategic Planning for Kosovo Peace Keeping Force**
Altinsoy, Nuh; Sep. 2001; 101p; In English; Original contains color images
Report No.(s): AD-A397234; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This thesis presents a model of a detailed strategic information plan for a military organization. The model includes the analysis and design of a network and a three-tier client server system. The network analysis focuses on the network traffic flow using Ethernet and Token Ring models, Each candidate technology is simulated with Extend 4,0, Average latency and waiting time in the queue are the simulation parameters. The selection of the candidate technology will play an important role in the implementation of the intranet for the organization. The three-tier client/server system includes the design and implementation of a relational database, which is connected to the intranet. The database is created with Access 2000. The database connectivity from back-end to front-end is constructed by Active Server Pages (ASP), which enables the users to manipulate the database via their web browsers. The intranet pages are built with Microsoft Front Page 2000. This prototype will permit this organization to initiate a tmnsformation from paper-based environment to the paperless world.
DTIC
*Computer Networks; Information Systems; Relational Data Bases; Mathematical Models*

**20020020969** Army War Coll., Strategic Studies Inst., Carlisle Barracks, PA USA
**Chinese Information Warfare: A Phantom Menace or Emerging Threat**
Yoshihara, Toshi; Nov. 2001; 51p; In English
Report No.(s): AD-A397266; ISBN-1-58487-074-5; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The author explores what he perceives to be China's pursuit of information warfare (IW) as a method of fighting asymmetric warfare against the USA. He believes the Chinese are seeking ways to adapt IW to their own style of warfare. Paradoxically, he observes that the Chinese have not gleaned their intelligence through espionage, but through careful scrutiny of U.S. IW in practice. The author examines those aspects of IW (PSYOPS (psychological operations), Denial, and Deception) that China believes provides the greatest prospects for victory in a conflict. Not surprisingly, Sun Tzu is interwoven into this emerging theory. Targeting the enemy's nervous system at all levels, that is, his ability to gather and assess information and then transmit orders, provides significant advantages in the prosecution of a campaign. He concludes that the extent of Chinese advances or intent regarding IW is difficult to ascertain given its closed society. Chinese IW may still be nascent, but the menacing intent is there and only vigilance will protect the USA.
DTIC
*China; Electronic Warfare; Computer Information Security; Information Management; Military Operations*

**20020021285** National Inst. of Standards and Technology, Gaithersburg, MD USA
**Guide to Documentary Standards**
DeVaux, C. R.; Dec. 2001; 38p; In English
Report No.(s): PB2001-109032; NISTIR-6802; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This Guide is intended to provide information on the U.S. standards system, entities within that system, and different types of documentary standards. It includes descriptions of performance and design standards; voluntary consensus standards; defense standards; de facto standards; industry standards; consortia standards; and international standards. In addition, the Guide includes information on the implementation of the National Technology Transfer and Advancement Act (NTTAA) and on the link between standards and conformity assessment.
NTIS
*Organizations; Documentation; Technology Assessment; Standards*

## 83
## ECONOMICS AND COST ANALYSIS

*Includes cost effectiveness studies.*

**20020016262** RAND Corp., Santa Monica, CA USA
**Military Airframe Acquisition Costs: The Effects of Lean Manufacturing**
Cook, Cynthia R.; Graser, John C.; Jan. 2001; 165p; In English
Contract(s)/Grant(s): F49842-96-C-0001
Report No.(s): AD-A396702; RAND/MR-1325-AF; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report is part of a project responding to a call by the US Air Force to update cost estimating methodologies for new weapons systems - in particular, fighter aircraft. The Air Force was concerned that Cost Estimating Relationships (CERs) based on older aircraft did not adequately reflect the acquisition and manufacturing environment within which a new fighter, such as the Joint Strike Fighter (JSF) would be produced. This report is one of a series, all of which address some aspect of how to incorporate the new Department of Defense acquisition and manufacturing environments into historical cost estimating relationships or methodologies. Using the CER methodology for example, the cost of a future aircraft is estimated as a function of its physical or characteristics or other program variables, using a series of equations wherein the performance and program variables are inputs, and cost or labor hours are the outputs. to create these equations, actual costs (or labor hours) to produce previous aircraft are collected and used as the dependent variables in statistical regression analysis. Explanatory variables typically include such factors as cumulative production quantity, annual production rate, such aircraft characteristics as weight and speed, and others. The resulting equations are referred to as 'cost estimating relationships,' or CERs. Obviously, the ability of these equations to forecast future systems costs hinges on how well past performance is a predictor of the future.
DTIC
*Cost Estimates; Manufacturing; Statistical Analysis; Airframes*

## 89
## ASTRONOMY

*Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.*

**20020016469** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Kepler Mission: Detecting Earth-sized Planets in Habitable Zones**
Kondo, Yoji, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Millennium Philcon Conference, 30 Aug. - 3 Sep. 2001, Unknown; No Copyright; Avail: Issuing Activity; Abstract Only

The Kepler Mission, which is presently in Phase A, is being proposed for launch in 5 years for a 4-year mission to determine the frequency of Earth-sized or larger planets in habitable zones in our galaxy. Kepler will be placed in an Earth-trailing orbit to provide stable physical environments for the sensitive scientific instruments. The satellite is equipped with a photometric system with the precision of 10E-5, which should be sufficient for detecting the transits of Earth-sized or larger planets in front of dwarf stars similar to the Sun. Approximately 100,000 or more sun-like stars brighter than the 14th apparently magnitude will be monitored continuously for 4 years in a preselected region of the sky, which is about 100 square degrees in size. In addition, Kepler will have a participating scientist program that will enable research in intrinsic variable stars, interacting binaries including cataclysmic stars and X-ray binaries, and a large number of solar analogs in our galaxy. Several ten thousand additional stars may be investigated in the guest observer program open to the whole world.
Author
*Variable Stars; Regions; Planets; Photometry; Dwarf Stars; Brightness*

**20020016501** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Microshutter Array Development for the Multi-Object Spectrograph for the New Generation Space Telescope, and Its Ground-based Demonstrator**
Woodgate, Bruce E., NASA Goddard Space Flight Center, USA; Moseley, Harvey, NASA Goddard Space Flight Center, USA; Fettig, Rainer, NASA Goddard Space Flight Center, USA; Kutyrev, Alexander, NASA Goddard Space Flight Center, USA; Ge, Jian, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; AMOS 2001, 2001, Unknown; No Copyright; Avail: Issuing Activity; Abstract Only

The 6.5-m NASA/ESA/Canada New Generation Space Telescope to be operated at the L2 Lagrangian point will require a multi-object spectrograph (MOS) operating from 1 to 5 microns. Up to 3000 targets will be selected for simultaneous spectroscopy using a programmable cryogenic (approx. 35K) aperture array, consisting of a mosaic of arrays of micromirrors or microshutters. We describe the current status of the GSFC microshutter array development. The 100 micron square shutters are opened magnetically and latched open or closed electrostatically. Selection will be by two crossed one-dimensional addressing circuits. We will demonstrate the use of a 512 x 512 unit array on a ground-based IR MOS which will cover 0.6 to 5 microns, and operate rapidly to include spectroscopy of gamma ray burst afterglows.
Author
*Arrays; Fabrication; Gamma Ray Bursts; Microbalances; Camera Shutters*

**20020017032** NASA Goddard Space Flight Center, Greenbelt, MD USA
**The Strontium Filament within the Homunculus of Eta Carinae**
Gull, Theodore R., NASA Goddard Space Flight Center, USA; Hartman, H., Lund Univ., Sweden; Zethson, T., Lund Univ., Sweden; Johansson, S., Lund Univ., Sweden; Ishibashi, K., NASA Goddard Space Flight Center, USA; Davidson, K., Minnesota Univ., USA; [2001]; 1p; In English; 199th American Astronomical Society Meeting, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

During a series of HST/STIS observations of Eta Carinae and associated ejecta, we noticed a peculiar emission filament located a few arcseconds north of the central source. While bright in nebular standards, it is submerged in a sea of scattered starlight until moderately high dispersion, long-slit spectroscopy with the STIS (R- 8000) brings the emission lines out. The initial spectrum, centered on 6768A with the STIS G750M grating, led to identification of twenty lines from singly-Ionized species including [SR II], [Fe II], [Ti II], [Ni II], [Mn II], and [Co II] (Zethson, etal., 2001, AJ 122,322). No Balmer emission is detected from this filament and the Fe II 2507,9 lines, known to be pumped by Lyman alpha radiation in other regions near the central source, are not detected. Followup observations have led to detection of hundreds more emission lines from iron group elements in neutral and singly-ionized states. Thus far all are excited by less than 10 eV. This peculiar nebular emission is thought to be due to very intense stellar radiation, stripped of uv flux shortward of Lyman alpha, bathing a neutral structure. We are systematically identifying the many lines (over 90% identified) and measuring line intensities that will then be modeled to determine excitation mechanisms, temperature and density. Two [SR II] and two SR II lines have now been measured. Bautista, etal. (in preparation) have modeled the strontium flux ratios and find that large radiation fluxes and/or high strontium abundances may account for the detected emission. These observations were supported by STIS GTO funding and GO funding through the STScI
Author
*Strontium; Abundance; Emission Spectra; Ionization; Variable Stars*

**20020017760** Smithsonian Astrophysical Observatory, Cambridge, MA USA
**A Deep X-Ray Survey of Low Mass PMS Stars in NGC 2264** ***Annual Report, 15 Mar. 2001 - 14 Mar. 2002***
Patten, Brian M., Smithsonian Astrophysical Observatory, USA; December 2001; 1p; In English
Contract(s)/Grant(s): NAG5-10565; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have proposed to make a deep X-ray survey of a rotation- and proper-motion selected sample of young (3-15 Myr old), low-mass, pre-main sequence (PMS) stars in the populous star-forming region NGC 2264. These X-ray Multimirror Mission (XMM) data will be combined with an extensive set of rotation data for members of this cluster to allow us, for the first time, to probe the early evolution of magnetic dynamo activity for both fully convective stars and those stars found lower on their Hayashi tracks, which are developing radiative cores. We will use these data to study the interrelationship between rotation, interior structure, and coronal activity as a function of mass and age in the PMS and to define empirical constraints for theoretical models of angular momentum/dynamo evolution.
Author
*Magnetic Variations; Pre-Main Sequence Stars; Stellar Rotation; X Ray Astronomy; Stellar Models*

**20020018562** Space Telescope Science Inst., Baltimore, MD USA
**Ultraviolet Signatures of Stars and Gas in Starburst Galaxies** ***Final Report, 1 Feb. 1998 - 31 Jan. 2002***
Leitherer, Claus, Space Telescope Science Inst., USA; Oct. 18, 2001; 2p; In English
Contract(s)/Grant(s): NAG5-6903; STScI Proj. J0100; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We extracted about 500 short wavelength prime (SWP) (high-dispersion) International Ultraviolet Explorer (IUE) spectra of B0 to B8 stars of all luminosity classes for the purpose of creating a stellar library. Several hundred scientifically useful high-dispersion B-star spectra are in the IUE Archive. The data were taken either with the purpose of performing stellar-wind

studies or investigations of interstellar absorption lines. Due to the nature of these projects, the S/N of the data is the maximum achievable with the IUE satellite. Rountree and Sonneborn and Walborn, Parker, and Nichols extracted a subset of B spectral classification standards from the IUE Archive to construct atlases of IUE high-dispersion spectra. Their work served as our guideline for the data extraction.
Derived from text
*B Stars; Cosmic Gases; Spectral Signatures; Spectrum Analysis; Ultraviolet Spectra; Ultraviolet Astronomy*

**20020019234** NASA Ames Research Center, Moffett Field, CA USA
**Long-slit Spectra of the Red Rectangle at 3 Microns**
Sloan, G. C., NASA Ames Research Center, USA; Bregman, Jesse, NASA Ames Research Center, USA; Woodward, C. E., Wyoming Univ., USA; [1994]; 1p; In English; 185th American Astronomical Society Meeting, 8-13 Jan. 1995, Tucson, AZ, USA; Sponsored by American Astronomical Society, USA
Contract(s)/Grant(s): RTOP 352-02-03-01; No Copyright; Avail: Issuing Activity; Abstract Only
We have observed the Red Rectangle with the Cryogenic Spectrometer (CRSP) at the 2.1 m telescope of Kitt Peak National Observatory. The Red Rectangle is a well-known source of the infrared emission features associated with polycyclic aromatic hydrocarbons (PAHs). Our long-slit spectra cover the 3.2-3.6 micrometer regime, which includes the strong PAH band at 3.29 micrometers, a weaker component at 3.40 micrometers, and an emission plateau which continues out to 3.6 micrometers. Emission in the PAH bands extends several arcseconds to the north and south of the central source (HD 44179). The seeing during our observations was approximately 1.5 arcseconds, but we have deconvolved the point spread function from our spectral images at each wavelength using maximum entropy reconstruction, allowing us to examine the relative behavior of these emission components at finer spatial scales. With the new 256x256 array installed on CRSP, each pixel covers 0.6 arcseconds of sky. Our reconstructions reveal that the strength of the small 3.4 micrometer emission feature increases with respect to the 3.3 micrometer feature as the distance from the central source increases. In particular, there appears to be a region of enhanced 3.4 micrometer emission roughly 3” to the north and south of the central source. We are analyzing our results in terms of the competing models for the origin of the 3.4 micrometer emission feature, which could be a vibrational overtone of the 3.3 micrometer feature, or could result from the attachment of molecular sidegroups to the PAH molecule.
Author
*Spectra; Cryogenics; Spectrometers; Infrared Radiation; Polycyclic Aromatic Hydrocarbons*

**20020020360** NASA Marshall Space Flight Center, Huntsville, AL USA
**Properties of the Chandra Sources in M81**
Tennant, Allyn F., NASA Marshall Space Flight Center, USA; Wu, Kinwah, Sydney Univ., Australia; Ghosh, Kajal K., National Academy of Sciences - National Research Council, USA; Kolodziejczak, Jeffery J., NASA Marshall Space Flight Center, USA; Swartz, Douglas A., Universities Space Research Association, USA; Astrophysical Journal; Mar. 01, 2001; Volume 549, pp. L43-L46; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS5-2555; Copyright; Avail: Issuing Activity
The Chandra X-Ray Observatory obtained a 50 ks observation of the central region of M81 using the ACIS-S in imaging mode. The global properties of the 97 X-ray sources detected in the inner 8.3’ x 8.3’ field of M81 are examined. Roughly half the sources are concentrated within the central bulge. The remainder are distributed throughout the disk, with the brightest disk sources lying preferentially along spiral arms. The average hardness ratios of both bulge and disk sources are consistent with power-law spectra of index Gamma equals approximately 1.6, indicative of a population of X-ray binaries. A group of much softer sources is also present. The background-source-subtracted log N-log S distribution of the disk follows a power law of index approximately -0.5 with no change in slope over three decades in flux. The log N-log S distribution of the bulge follows a similar shape but with a steeper slope above approximately 4 x 10(exp 37) ergs/s. There is unresolved X-ray flux from the bulge with a radial profile similar to that of the bulge sources. This unresolved flux is softer than the average of the bulge sources, and extrapolating the bulge log N-log S distribution toward weaker sources can account for only 20% of the unresolved flux. No strong time variability was observed for any source with the exception of one bright, soft source.
Author
*X Ray Binaries; X Ray Sources; X Ray Astronomy; Spiral Galaxies; Morphology*

**20020020426** International Society for Optical Engineering, USA
**Optical Characteristics of the Marshall Space Flight Center Solar Ultraviolet Magnetograph**
West, E. A., NASA Marshall Space Flight Center, USA; Porter, J. G., NASA Marshall Space Flight Center, USA; Davis, J. M., NASA Marshall Space Flight Center, USA; Gary, G. A., NASA Marshall Space Flight Center, USA; Adams, M., NASA Marshall

Space Flight Center, USA; Smith, S., NASA Marshall Space Flight Center, USA; Hraba, J. F., NASA Marshall Space Flight Center, USA; [2001]; ISSN 0277-786X; 12p; In English; Optical Characteristics of the Marshall Space Flight Center Solar Ultraviolet Magnetograph, 1-2 Aug. 2001, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA; Copyright; Avail: Issuing Activity

This paper will describe the scientific objectives of the Marshall Space Flight Center (MSFC) Solar Ultraviolet Magnetograph Investigation (SUMI) and the optical components that have been developed to meet those objectives. In order to test the scientific feasibility of measuring magnetic fields in the UV, a sounding rocket payload is being developed. This paper will discuss: (1) the scientific measurements that will be made by the SUMI sounding rocket program, (2) how the optics have been optimized for simultaneous measurements of two magnetic lines CIV (1550 Angstroms) and MgII (2800 Angstroms), and (3) the optical, reflectance, transmission and polarization measurements that have been made on the SUMI telescope mirror and polarimeter. Author

*Magnetometers; Optical Properties; Solar Instruments; Polarimeters; Ultraviolet Radiation; Telescopes*

**20020020652** Lunar and Planetary Inst., Houston, TX USA

**On Orbital Elements of Extrasolar Planetary Candidates and Spectroscopic Binaries**

Stepinski, T. F., Lunar and Planetary Inst., USA; Black, D. C., Lunar and Planetary Inst., USA; Astronomy and Astrophysics; 2001; ISSN 0004-6361; Volume 371, pp. 250-259; In English

Contract(s)/Grant(s): NASW-4574

Report No.(s): LPI-Contrib-1086; Copyright; Avail: Issuing Activity

We estimate probability densities of orbital elements, periods, and eccentricities, for the population of extrasolar planetary candidates (EPC) and, separately, for the population of spectroscopic binaries (SB) with solar-type primaries. We construct empirical cumulative distribution functions (CDFs) in order to infer probability distribution functions (PDFs) for orbital periods and eccentricities. We also derive a joint probability density for period-eccentricity pairs in each population. Comparison of respective distributions reveals that in all cases EPC and SB populations are, in the context of orbital elements, indistinguishable from each other to a high degree of statistical significance. Probability densities of orbital periods in both populations have P(exp -1) functional form, whereas the PDFs of eccentricities can he best characterized as a Gaussian with a mean of about 0.35 and standard deviation of about 0.2 turning into a flat distribution at small values of eccentricity. These remarkable similarities between EPC and SB must be taken into account by theories aimed at explaining the origin of extrasolar planetary candidates, and constitute an important clue us to their ultimate nature. Author

*Orbital Elements; Extrasolar Planets; Binary Stars; Probability Distribution Functions*

## 90
## ASTROPHYSICS

*Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.*

**20020016295** Fermi National Accelerator Lab., Batavia, IL USA

**Chaotic mixing in charged-particle beams and galaxies**

Kandrup, H.; Kishek, R.; Bohn, C.; Oct. 03, 2001; 3p; In English

Report No.(s): DE2001-787342; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Self-interacting, nonequilibrium, very-many-body systems such as elliptical galaxies and charged-particle beams seem generically to exhibit rapid evolution to a quasi-equilibrium state. Such systems comprise some 10 10-12 particles. NTIS

*Charged Particles; Elliptical Galaxies; Astrophysics; Particle Beams*

**20020016369** Fermi National Accelerator Lab., Batavia, IL USA

**Small scale anisotropies of UHECRs from super-heavy halo dark matter**

Blasi, P.; Sheth, R. K.; Oct. 23, 2001; 4p; In English

Report No.(s): DE2001-787842; No Copyright; Avail: Department of Energy Information Bridge

The decay of very heavy metastable relics of the Early Universe can produce ultra-high energy cosmic rays (UHECRs) in the halo of our own Galaxy. In this model, no Gresien-Zatsepin-Kuzmin cutoff is expected because of the short propagation distances. We show here that, as a consequence of the hierarchical build up of the halo, this scenario predicts the existence of small scale anisotropies in the arrival directions of UHECRs, in addition to a large scale anisotropy, known from previous studies. We

also suggest some other observable consequences of this scenario which will be testable with upcoming experiments, as Auger, EUSO and OWL.
NTIS
*Anisotropy; Dark Matter; Energy Spectra*

**20020016398** NASA Goddard Space Flight Center, Greenbelt, MD USA
**The Little Homunculus of Eta Carinae: Ejection Date, Gas Temperature and Reddening Values**
Ishibashi, K., NASA Goddard Space Flight Center, USA; Davidson, K., Minnesota Univ., USA; Gull, T. R., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; AAS 199th Conference, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

HST/STIS spectral monitoring of Eta Carinae and its ejecta reveals the presence of a relatively small bipolar structure inside the central regions of the familiar Homunculus lobes. Astrometric analysis shows that the Little Homunculus was most likely ejected during the 1890 event. Here we employ a simple plasma analysis on the ejecta: (1) identify the forbidden [Fe II] lines, and (2) use them with a Boltzmann distribution to estimate a locus in ”gas temperature” -versus- ”Reddening” parameter space. Our preliminary result shows that gas temperature of the Little Homunculus may be around 5000 K with reddening E(B-V) approx. = 0.5 of a standard interstellar reddening is valid.
Author
*Gas Temperature; Data Acquisition; Stellar Spectra; Interstellar Extinction*

**20020016492** NASA Ames Research Center, Moffett Field, CA USA
**Isotopic Measurements of Organic Sulfonates From The Murchison Meteorite**
Cooper, G. W., NASA Ames Research Center, USA; Chang, S., NASA Ames Research Center, USA; [1995]; 1p; In English; 25th Lunar and Planetary Science Conference, 13-17 Mar. 1995, Houston, TX, USA
Contract(s)/Grant(s): RTOP 152-13-60; No Copyright; Avail: Issuing Activity; Abstract Only

Organic sulfonates and phosphonates have been extracted from the Murchison meteorite for stable isotope measurements. Preliminary stable isotope measurements of individual alkyl sulfonates, R-SO3H (R=C(sub n)H(sub 2n+l)), are shown. These compounds were found in aqueous extracts of Murchison. Both groups show trends similar to other homologous series of organic compounds indigenous to Murchison. Molecular abundances decrease with increasing carbon number, and all possible isomers at each carbon number (through C-4) are present. Carbon isotope measurements of the sulfonates show a decrease in the C-13/C-12 ratio with increasing carbon number. The overall objectives of this project are to obtain dime element carbon, hydrogen, and sulfur - intramolecular isotopic analyses of individual sulfonates, and isotopic measurement of carbon and hydrogen of the phosphonates as a group. The Murchison meteorite is the best characterized carbonaceous chondrite with respect to organic chemistry. The finding of organic sulfonates and phosphonates in Murchison is of interest because they are the first well-characterized series of sulfur and phosphorus containing organic compounds found in meteorites. Also, meteorites, comets, and interplanetary dust particles may have been involved in chemical evolution on the early Earth. Because of the critical role of organic phosphorus and sulfur in all living systems, it is particularly interesting to see examples of abiotic syntheses of these classes of compounds. The study of the isotopic composition of the sulfonates and phosphonates can yield insight into their possible interstellar origin as well as their mechanisms of synthesis in the early solar system. Previous isotopic analyses of other classes of organic compounds indigenous to meteorites, e.g., amino acids, carboxylic acids, and hydrocarbons indicate the possibility that interstellar molecules were incorporated into meteorite parent bodies. In these compounds the ratios of heavy to light isotopes of hydrogen (D/H), carbon (C-13/C-12), and nitrogen (N-15/N-14), are anomalous relative to bulk terrestrial and meteoritic values. In some cases, the D/H ratios approach those observed for molecules in interstellar clouds.
Author
*Isotopes; Sulfonates; Organic Compounds; Murchison Meteorite; Phosphorus; Extraction; Alkyl Compounds*

**20020016499** NASA Goddard Space Flight Center, Greenbelt, MD USA
**The Origin of Hot Subluminous Horizontal-Branch Stars in Omega Cen and NGC 2808**
Sweigart, A. V., NASA Goddard Space Flight Center, USA; Brown, T. M., Space Telescope Science Inst., USA; Moehler, S., Bamberg Univ., Germany; Lanz, T., NASA Goddard Space Flight Center, USA; Landsman, W. B., Science Systems and Applications, Inc., USA; Hubeny, I., NASA Goddard Space Flight Center, USA; Napiwotzki, R., Bamberg Univ., Germany; Driezler, S., Tuebingen Univ., Germany; [2001]; 1p; In English; AAS 199th Conference, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Ultraviolet observations of the globular clusters omega Cen and NGC 2808 have revealed an unexpected population of hot subluminous stars lying up to 0.7 mag below the extreme horizontal branch (EHB), which axe not explained by canonical stellar

models. In order to explore the evolutionary status of these stars, we have evolved a set of low-mass stars from the main sequence through the helium flash to the horizontal branch (HB) for a wide range in the mass loss along the red-giant branch (RGB). Stars with the largest mass loss evolve off the RGB to high effective temperatures before igniting helium in their cores. Our results indicate that the subluminous stars can be explained if these stars undergo a late helium flash while descending the white dwarf cooling curve. Under these conditions the convection zone produced by the helium flash will penetrate into the stellar envelope, thereby mixing the envelope hydrogen into the hot helium-burning interior, where it is rapidly consumed. Such ”flashmixed” stars will have helium- and carbon-rich envelopes and will lie at higher effective temperatures than the hottest canonical (i.e., unmixed) EHB stars. Using new stellar atmospheres, we show that these changes in the envelope abundances will suppress the ultraviolet flux in the spectra of the flash-mixed stars by the amount needed to explain the hot subluminous stars in w Cen and NGC 2808. to test this evolutionary scenario, we have obtained medium resolution spectra of a sample of the hottest HB stars in omega Cen. We find that these stars axe indeed helium-rich compared to classical EHB stars and also considerably hotter than the hottest EHB models without flash mixing.
Author
*A Stars; Ultraviolet Spectra; Globular Clusters; Hot Stars; Stellar Atmospheres; Red Giant Stars*

**20020017265** Smithsonian Astrophysical Observatory, Cambridge, MA USA
**”A Richness Study of 14 Distant X-Ray Clusters from the 160 Square Degree Survey”** ***Annual Report, 1 Oct. 2000 - 30 Sep. 2001***
Jones, Christine, Smithsonian Astrophysical Observatory, USA; December 2001; 2p; In English
Contract(s)/Grant(s): NAG5-3064; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
We have measured the surface density of galaxies toward 14 X-ray-selected cluster candidates at redshifts z(sub i) 0.46, and we show that they are associated with rich galaxy concentrations. These clusters, having X-ray luminosities of Lx(0.5-2 keV) approx. (0.5 - 2.6) x 10(exp 44) ergs/ sec are among the most distant and luminous in our 160 deg(exp 2) ROSAT Position Sensitive Proportional Counter cluster survey. We find that the clusters range between Abell richness classes 0 and 2 and have a most probable richness class of 1. We compare the richness distribution of our distant clusters to those for three samples of nearby clusters with similar X-ray luminosities. We find that the nearby and distant samples have similar richness distributions, which shows that clusters have apparently not evolved substantially in richness since redshift z=0.5. There is, however, a marginal tendency for the distant clusters to be slightly poorer than nearby clusters, although deeper multicolor data for a large sample would be required to confirm this trend. We compare the distribution of distant X-ray clusters in the L(sub X)-richness plane to the distribution of optically selected clusters from the Palomar Distant Cluster Survey. The optically selected clusters appear overly rich for their X-ray luminosities, when compared to X-ray-selected clusters. Apparently, X-ray and optical surveys do not necessarily sample identical mass concentrations at large redshifts. This may indicate the existence of a population of optically rich clusters with anomalously low X-ray emission, More likely, however, it reflects the tendency for optical surveys to select unvirialized mass concentrations, as might be expected when peering along large-scale filaments.
Author
*X Rays; Cluster Analysis; Surface Properties; Galaxies; Flux Density*

**20020017519** Colorado Univ., Colorado Center for Astrodynamics Research, Boulder, CO USA
**Implementation of Altimetry Data in the GIPSY POD Software Package** ***Final Report***
Stauch, Jason R., Colorado Univ., USA; Gold, Kenn, Colorado Univ., USA; Born, George H., Colorado Univ., USA; Jan. 31, 2001; 10p; In English
Contract(s)/Grant(s): JPL-1218656
Report No.(s): CCAR-TM-2001-03-015; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Altimetry data has been used extensively to acquire data about characteristics of the Earth, the Moon, and Mars. More recently, the idea of using altimetry for orbit determination has also been explored. This report discusses modifications to JPL’s GIPSY/OASIS II software to include altimetry data as an observation type for precise orbit determination. The mathematical foundation of using altimetry for the purpose of orbit determination is presented, along with results.
Author
*Altimetry; Applications Programs (Computers); Orbit Determination*

**20020017524** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Tentative Identification of Interstellar CS by UV Absorption in the C-X Transition**
Smith, Andrew, NASA Goddard Space Flight Center, USA; Lyu, C.-H., Caelum Research Corp., USA; Bruhweiler, F. C., Catholic Univ. of America, USA; [2001]; 1p; In English; 199th American Astronomical Society Meeting, 6-10 Jan. 2002, Washington, DC,

USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Current chemical models of translucent clouds imply that sulfur is depleted with respect to its average abundance in diffuse clouds as determined by Morton (1975 ApJ,197, 85) by factors exceeding 10. Existing gigahertz emission observations yield sizable uncertainties in the column densities to background stars, and attempts to measure column densities of CS in the lines-of-sight to various stars through the absorption in the A-X (0,0) electronic transition near 257.6 nm have been unsuccessful. CS dissociates primarily through discrete absorptions into predissociating states. In analogy with CO the strongest of these is the C-X band found near 140.0 nm. We report the tentative identification of the C-X band of CS in the interstellar spectra of HD 24398 (zeta Per), HD 148184 (chi Oph), and HD 154368. The estimated column densities will be compared to the predictions of prevailing chemical models.

Author

*Analogies; C Band; Ultraviolet Absorption; Interstellar Matter; Translucence; Chemical Clouds*

**20020019235** NASA Ames Research Center, Moffett Field, CA USA

**Multiple Core Galaxies: Implications for M31**

Smith, B. F., NASA Ames Research Center, USA; Miller, R. H., Chicago Univ., USA; [1994]; 1p; In English; American Astronomical Society Meeting, 7-12 Jan. 1995, Tucson, AZ, USA; Sponsored by American Astronomical Society, USA

Contract(s)/Grant(s): RTOP 188-44-53; No Copyright; Avail: Issuing Activity; Abstract Only

It is generally perceived that two cores cannot survive very long within the nuclear regions of a galaxy. The recent HST discovery of a double nucleus in M31 brings this question into prominence. Physical conditions in the nuclear regions of a typical galaxy help a second core survive so it can orbit for a long time, possibly for thousands of orbits. Given the nearly uniform mass density in a core, tidal forces within a core radius are compressive in all directions and help the core survive the buffeting it takes as it orbits near the center of the galaxy. We use numerical experiments to illustrate these physical principles. Modifications to the experimental method allow the full power of the experiments to be concentrated on the nuclear regions. Spatial resolution of about 0.2 parsec comfortably resolves detail within the 1.4 parsec core radius of the second, but brighter, core (P1) in M31. The same physical principles apply in other astronomical situations, such as dumbbell galaxies, galaxies orbiting near the center of a galaxy cluster, and subclustering in galaxy clusters. The experiments also illustrate that galaxy encounters and merging are quite sensitive to external tidal forces, such as those produced by the gravitational potential in a group or cluster of galaxies.

Author

*Andromeda Galaxy; Cores; Tides*

**20020019796** NASA Marshall Space Flight Center, Huntsville, AL USA

**Photoemission Experiments for Charge Characteristics of Individual Dust Grains**

Abbas, M. M., NASA Marshall Space Flight Center, USA; Craven, P. D., NASA Marshall Space Flight Center, USA; Spann, J. F., NASA Marshall Space Flight Center, USA; West, E., NASA Marshall Space Flight Center, USA; Pratico, J., Alabama Univ., USA; Tankosic, D., Alabama Univ., USA; Venturini, C. C., Alabama Univ., USA; [2001]; 2p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

Photoemission experiments with UV radiation have been performed to investigate the microphysics and charge characteristics of individual isolated dust grains of various compositions and sizes by using the electrodynamic balance facility at NASA Marshall Space Flight Center. Dust particles of 2-10 gm diameter are levitated in a vacuum chamber at pressures approximately 10(exp-5) torr and exposed to a collimated beam of UV radiation in the 120-200 nm spectral range from a deuterium lamp source with a MgF2 window. A monochromator is used to select the UV wavelength with a spectral resolution of 8 nm. The electrodynamic facility permits measurements of the charge and diameters of particles of known composition, and monitoring of photoemission rates with the incident UV radiation. Experiments have been conducted on test particles of silica and polystyrene to determine the photoelectric yields and surface equilibrium potentials when exposed to UV radiation. A brief description of an experimental procedure for photoemission studies is given and some preliminary laboratory measurements of the photoelectric yields of individual dust particles are presented.

Author

*Dust; Photoelectric Emission; Granular Materials; Monochromators; Composition (Property); Grain Size*

**20020020170** NASA Marshall Space Flight Center, Huntsville, AL USA

**Material Outflows from Coronal Intensity ”Dimming Regions” during Coronal Mass Ejection Onset**

Harra, Louise K., Mullard Space Science Lab., UK; Sterling, Alphonse C., NASA Marshall Space Flight Center, USA; Astrophysical Journal; Nov. 10, 2001; Volume 561, pp. L215-L218; In English; Copyright; Avail: Issuing Activity

One signature of expulsion of coronal mass ejections (CMEs) from the solar corona is the appearance of transient intensity dimmings in coronal images. These dimmings have generally been assumed to be due to discharge of CME material from the corona, and thus the 'dimming regions' are thought of as an important signature of the sources of CMEs. We present spectral observations of two dimming regions at the time of expulsion of CMEs, using the Coronal Diagnostic Spectrometer (CDS) on the SOHO satellite. One of the dimming regions is at the solar limb and associated with a CME traveling in the plane of the sky, while the other region is on the solar disk and associated with an Earth-directed 'halo' CME. From the limb event, we see Doppler signatures of approximately 30 km/s in coronal (Fe XVI and Mg IX) emission lines, where the enhanced velocities coincide with the locations of coronal dimming. This provides direct evidence that the dimmings are associated with outflowing material. We also see larger (approximately 100 km/s) Doppler velocities in transition region (O V and He I) emission lines, which are likely to be associated with motions of a prominence and loops at transition region temperatures. An 'EIT wave' accompanies the disk event, and a dimming region behind the wave shows strong blueshifted Doppler signatures of approximately 100 km/s in O V, suggesting that material from the dimming regions behind the wave may be feeding the CME.
Author
*Coronal Mass Ejection; Solar Corona; Dimming; Solar Limb*

**20020020654** NASA Marshall Space Flight Center, Huntsville, AL USA
**The Intensity Distribution of Faint Gamma-Ray Bursts Detected with BATSE**
Kommers, Jefferson M., Massachusetts Inst. of Tech., USA; Lewin, Walter H. G., Massachusetts Inst. of Tech., USA; Kouveliotou, Chryssa, NASA Marshall Space Flight Center, USA; vanParadus, Jan, Alabama Univ., USA; Pendleton, Geoffrey N., Alabama Univ., USA; Meegan, Charles A., NASA Marshall Space Flight Center, USA; Fishman, Gerald J., NASA Marshall Space Flight Center, USA; Astrophysical Journal; Apr. 20, 2000; Volume 533, pp. 696-709; In English
Contract(s)/Grant(s): NGT8-52816; NAG5-3804; NAG5-32490; NAG5-4799; NAG5-2755; NAG5-3674; Copyright; Avail: Issuing Activity

We have recently completed a search of six years of archival Burst and Transient Source Experiment (BATSE) data for gamma-ray bursts (GRBs) that were too faint to activate the real-time burst detection system running on board the spacecraft. These 'nontriggered' bursts can be combined with the 'triggered' bursts detected on board to produce a GRB intensity distribution that reaches peak fluxes a factor of approximately two lower than could be studied previously. The value of the V/V (sub max) statistic (in Euclidean space) for the bursts we detect is 0.177 +/- 0.006. This surprisingly low value is obtained because we detected very few bursts on the 4.096 s and 8.192 s timescales (where most bursts have their highest signal-to-noise ratio) that were not already detected on the 1.024 s timescale. If allowance is made for a power-law distribution of intrinsic peak luminosities, the extended peak flux distribution is consistent with models in which the redshift distribution of the gamma-ray burst rate approximately traces the star formation history of the universe. We argue that this class of models is preferred over those in which the burst rate is independent of redshift. We use the peak flux distribution to derive a limit of 10% (99% confidence) on the fraction of the total burst rate that could be contributed by a spatially homogeneous (in Euclidean space) subpopulation of burst sources, such as type Ib/c supernovae. These results lend support to the conclusions of previous studies predicting that relatively few faint 'classical' GRBs will be found below the BATSE onboard detection threshold.
Author
*Gamma Ray Bursts; Gamma Ray Astronomy; Luminous Intensity*

**20020020655** NASA Marshall Space Flight Center, Huntsville, AL USA
**EIT Crinkles as Evidence for the Breakout Model of Solar Eruptions**
Sterling, Alphonse C., NASA Marshall Space Flight Center, USA; Moore, Ronald L., NASA Marshall Space Flight Center, USA; Astrophysical Journal; Oct. 20, 2001; Volume 560, pp. 1045-1057; In English; Original contains color illustrations; Copyright; Avail: Issuing Activity

We present observations of two homologous flares in NOAA Active Region 8210 occurring on 1998 May 1 and 2, using EUV data from the EUV Imaging Telescope (EIT) on board the Solar and Heliospheric Observatory, high-resolution and high-time cadence images from the soft X-ray telescope on Yohkoh, images or fluxes from the hard X-ray telescope on Yohkoh and the BATSE experiment on board the Compton Gamma Ray Observatory, and Ca(XIX) soft X-ray spectra from the Bragg crystal spectrometer (BCS) on Yohkoh. Magnetograms indicate that the flares occurred in a complex magnetic topology, consisting of an emerging flux region (EFR) sandwiched between a sunspot to the west and a coronal hole to the east. In an earlier study we found that in EIT images, both flaring episodes showed the formation of a crinkle-like pattern of emission (EIT crinkles) occurring in the coronal hole vicinity, well away from a central 'core field' area near the EFR-sunspot boundary. With our expanded data set, here we find that most of the energetic activity occurs in the core region in both events, with some portions of the core brightening shortly after the onset of the EIT crinkles, and other regions of the core brightening several minutes later, coincident

with a burst of hard X-rays; there are no obvious core brightenings prior to the onset of the EIT crinkles. These timings are consistent with the 'breakout model' of solar eruptions, whereby the emerging flux is initially constrained by a system of overlying magnetic field lines, and is able to erupt only after an opening develops in the overlying fields as a consequence of magnetic reconnection at a magnetic null point. In our case, the EIT crinkles would be a signature of this pre-impulsive phase magnetic reconnection, and brightening of the core only occurs after the core fields begin to escape through the newly created opening in the overlying fields. Morphology in soft X-ray images and properties in hard X-rays differ between the two events, with complexities that preclude a simple determination of the dynamics in the core at the times of eruption. From the BCS spectra, we find that the core region expends energy at a rate of approximately 10(exp 26) ergs/s during the time of the growth of the EIT crinkles; this rate is an upper limit to energy expended in the reconnections opening the overlying fields. Energy losses occur at an order of magnitude higher rate near the time of the peak of the events. There is little evidence of asymmetry in the spectra, consistent with the majority of the mass flows occurring normal to the line of sight. Both events have similar electron temperature dependencies on time.
Author
*Solar X-Rays; Solar Corona; Coronal Mass Ejection; Solar Flares; Ultraviolet Radiation*

## 91
## LUNAR AND PLANETARY SCIENCE AND EXPLORATION

*Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.*

**20020016484** RECOM Technologies, Inc., Moffett Field, CA USA
**World-Wide Web Tools for Locating Planetary Images**
Kanefsky, Bob, RECOM Technologies, Inc., USA; [1995]; 2p; In English; 26th Annual Lunar and Planetary Science Conference, 13-17 Mar. 1995, Houston, TX, USA
Contract(s)/Grant(s): RTOP 233-03-05; No Copyright; Avail: Issuing Activity; Abstract Only

The explosive growth of the World-Wide Web (WWW) in the past year has made it feasible to provide interactive graphical tools to assist scientists in locating planetary images. The highest available resolution images of any site of interest can be quickly found on a map or plot, and, if online, displayed immediately on nearly any computer equipped with a color screen, an Internet connection, and any of the free WWW browsers. The same tools may also be of interest to educators, students, and the general public. Image finding tools have been implemented covering most of the solar system: Earth, Mars, and the moons and planets imaged by Voyager. The Mars image-finder, which plots the footprints of all the high-resolution Viking Orbiter images and can be used to display any that are available online, also contains a complete scrollable atlas and hypertext gazetteer to help locating areas. The Earth image-finder is linked to thousands of Shuttle images stored at NASA/JSC, and displays them as red dots on a globe. The Voyager image-finder plots images as dots, by longitude and apparent target size, linked to online images. The locator (URL) for the top-level page is http: //ic-www.arc.nasa.gov/ic/projects/bayes-group/Atlas/. Through the efforts of the Planetary Data System and other organizations, hundreds of thousands of planetary images are now available on CD-ROM, and many of these have been made available on the WWW. However, locating images of a desired site is still problematic, in practice. For example, many scientists studying Mars use digital image maps, which are one third the resolution of Viking Orbiter survey images. When they douse Viking Orbiter images, they often work with photographically printed hardcopies, which lack the flexibility of digital images: magnification, contrast stretching, and other basic image-processing techniques offered by off-the-shelf software. From the perspective of someone working on an experimental image processing technique for super-resolution, the discovery that potential users are often not using the highest resolution already available, nor using conventional image processing techniques, was surprising. This motivated the present work.
Derived from text
*Mars Photographs; Planetary Mapping; World Wide Web; Position (Location); Image Processing*

**20020017759** NASA Ames Research Center, Moffett Field, CA USA
**The Organic Content of the Tagish Lake Meteorite**
Pizzarello, Sandra, Arizona State Univ., USA; Huang, Yongsong, Brown Univ., USA; Becker, Luann, California Univ., USA; Poreda, Robert J., Rochester Univ., USA; Nieman, Ronald A., Arizona State Univ., USA; Cooper, George, NASA Ames Research Center, USA; Williams, Michael, Arizona State Univ., USA; Science; Sep. 21, 2001; Volume 293, pp. 2236-2239; In English
Contract(s)/Grant(s): NAG5-9451; Copyright; Avail: Issuing Activity

The Tagish Lake meteorite felt last year on a frozen take in Canada and may provide the most pristine material of its kind. Analyses have now shown this carbonaceous chondrite to contain a suite of soluble organic compounds (approximately 100 parts per million) that includes mono- and dicarboxylic acids, dicarboximides, pyridine carboxylic acids, a sulfonic acid, and both aliphatic and aromatic hydrocarbons. The insoluble carbon exhibits exclusive aromatic character, deuterium enrichment, and fullerenes containing 'planetary' helium and argon. The findings provide insight into an outcome of early solar chemical evolution that differs from any seen so far in meteorites.
Author
*Carbonaceous Chondrites; Chemical Evolution; Organic Compounds; Chemical Composition*

**20020017761** Colorado Univ., Colorado Center for Astrodynamics Research, Denver, CO USA
**Mars Constellation Design** ***Final Report***
May 31, 2001; 11p; In English
Contract(s)/Grant(s): JPL-1214587; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
In this study, several different Mars constellation designs were evaluated. Various figures of merit were used to examine constellation configurations in order to optimize the performance of Mars Network. Plots were also obtained in order to make a clear comparison of the various figures of merit. In the following analysis, six figures of merit were used in the comparison (average time to achieve a 1 meter fix, maximum time to achieve a 1 meter fix, maximum wait time between satellite sightings, percent of time a satellite is in view, percent of cases to achieve a 1 meter fix in 10 minutes, and percent of cases to achieve a 1 meter fix in 1 hour). For the communication figures of merit (maximum wait time between satellite sightings and percent of time a satellite is in view), an initial run over a period of 10 days was used to produce the data. For the remaining figures of merit, the simulation was first restarted at least 100 times over a period of 1000 Earth days. Each time the simulation was continued until a 1 meter fix was achieved at all stations. The ground station grid was spaced 20 deg in longitude and 5 deg in latitude. In order to obtain the following graphs the values were first averaged over longitude and then an average of the positive and negative latitude values was made (i.e., -90 deg lat and 90 deg lat were averaged). In each case, the resulting figures of merit are shown. For some cases, the difference between the given case and the 'Eagles 2 Satellites' case is also given.
Author
*Satellite Constellations; Computerized Simulation; Configuration Management; Correction; Spatial Distribution*

**20020019232** NASA Ames Research Center, Moffett Field, CA USA
**Long-Slit Spectra of Mars in the Thermal Infrared**
Rowland, C. M., Stetson Univ., USA; Sloan, G. C., NASA Ames Research Center, USA; Roush, T., NASA Ames Research Center, USA; [1994]; 1p; In English; 185th American Astronomical Society Meeting, 8-13 Jan. 1995, Tucson, AZ, USA; Sponsored by American Astronomical Society, USA
Contract(s)/Grant(s): RTOP 352-02-03-01; No Copyright; Avail: Issuing Activity; Abstract Only
We have obtained long-slit spectra of Mars in the 7-14 micrometer regime. Our two integrations, taken 1993 March 2, are spaced about 2 hours apart and are centered at longitudes of roughly 210 and 240 degrees. The data cover the Elysium Planitia and volcanic regions, the classical dark albedo regions of Cerburus and central and eastern Hesperia, and the classical bright albedo region Utopia Planitia. We have deconvolved the point spread function from the images using a maximum entropy reconstruction algorithm; the resulting spatial resolution of the images is better than 1". Mars occupies approximately 9" of the slit, and we have detected variations in the spectral emission from different areas of the planet. We are in the process of interpreting these spectral variations in terms of the temperature and composition of the surface and the transmission of the Martian atmospheric dust and gases.
Author
*Spectra; Mars (Planet); Infrared Radiation; Mars Surface*

**20020019794** NASA Marshall Space Flight Center, Huntsville, AL USA
**Discovery of Soft X-Ray Emission from Io, Europa and the Io Plasma Torus**
Elsner, R. F., NASA Marshall Space Flight Center, USA; Gladstone, G. R., Southwest Research Inst., USA; Waite, J. H., Michigan Univ., USA; Crary, F. J., Michigan Univ., USA; Howell, R. R., Wyoming Univ., USA; Johnson, R. E., Virginia Univ., USA; Ford, P. G., Massachusetts Inst. of Tech., USA; Metzger, A. E., Jet Propulsion Lab., California Inst. of Tech., USA; Hurley, K. C., California Univ., USA; Feigelson, E. D., Pennsylvania State Univ., USA; [2001]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only
The Chandra X-ray Observatory observed the Jovian system for about 24 hours on 25-26 Nov 1999 with the Advanced CCD Imaging Spectrometer (ACIS), in support of the Galileo flyby of Io, and for about 10 hours on 18 Dec 2000 with the imaging array

of the High Resolution Camera (HRC-I), in support of the Cassini flyby of Jupiter. Analysis of these data have revealed soft (0.25--2 keV) x-ray emission from the moons Io and Europa, probably Ganymede, and from the Io Plasma Torus (IPT). Bombardment by energetic (greater than 10 keV) H, O, and S ions from the region of the IPT seems the likely source of the x-ray emission from the Galilean moons. According to our estimates, fluorescent x-ray emission excited by solar x-rays is about an order of magnitude too weak even during flares from the active Sun to account for the observed x-ray flux from the IPT. Charge-exchange processes, previously invoked to explain Jupiter's x-ray aurora and cometary x-ray emission, and ion stripping by dust grains both fall by orders of magnitude. On the other hand, we calculate that bremsstrahlung emission of soft X-rays from non-thermal electrons in the few hundred to few thousand eV range accounts for roughly one third of the observed x-ray flux from the IPT. Extension of the far ultraviolet (FUV) IPT spectrum likely also contributes.
Author
*Europa; Io; Jupiter (Planet); Toroidal Plasmas; X Rays; Imaging Spectrometers*

**20020019795** NASA Marshall Space Flight Center, Huntsville, AL USA
**Chandra Observations of X-Rays from Jupiter During the Cassini Flyby**
Gladstone, G. R., Southwest Research Inst., USA; Waite, J. H., Michigan Univ., USA; Grodent, D. C., Michigan Univ., USA; Crary, F. J., Michigan Univ., USA; Elsner, R. F., NASA Marshall Space Flight Center, USA; Weisskopf, M. C., NASA Marshall Space Flight Center, USA; Majeed, T., Southwest Research Inst., USA; Lewis, W. S., Southwest Research Inst., USA; Jahn, J.-M., Southwest Research Inst., USA; Bhardwaj, A., Vikram Sarabhai Space Centre, India; [2001]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

"Observations of jovian x-rays made with the Earth-orbiting Chandra x-ray observatory on 18 December 2000 in support of the Cassini flyby of Jupiter demonstrate that most of Jupiters northern auroral x-rays come from a hot spot located poleward of the main auroral oval and magnetically connected to a region in the outer magnetosphere beyond 30 jovian radii. The hot spot is fixed in magnetic latitude and longitude and occurs in a region where anomalous infrared1-5and ultraviolet6 emissions have been observed. The auroral x-ray emissions were observed to pulsate with an approximately 40-minute period, a period similar to that reported for high-latitude radio and energetic electron bursts observed by Ulysses7, and by Galileo and Cassini.8 These results call into question the prevailing view that the jovian x-ray emissions are excited by the steady precipitation of energetic heavy ions from the outer edge of the Io plasma torus and are forcing a reconsideration of our understanding of the source mechanisms and energetics of the jovian x-ray aurora."
Author
*Flyby Missions; Jupiter (Planet); X Ray Astrophysics Facility; Auroras; Galileo Spacecraft*

**20020020173** State Univ. of New York, Dept. of Geosciences, Stony Brook, NY USA
**Sedimentary Geochemistry of Martian Samples from the Pathfinder Mission** ***Final Report, 1 Mar. 1999 - 31 Aug. 2001***
McLennan, Scott M., State Univ. of New York, USA; [2001]; 3p; In English
Contract(s)/Grant(s): NAG5-58169; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The purpose of this research project was to evaluate the APXS data collected on soils and rocks at the Pathfinder site in terms of sedimentary geochemistry. Below are described the major findings of this research: (1) An influential model to explain the chemical variation among Pathfinder soils and rocks is a two component mixing model where rocks of fairly uniform composition mix with soil of uniform composition; (2) The very strong positive correlation between MgO and SO, points to a control by a MgSO4 mineral however, spectroscopic data continue to suggest that Fe-sulfates, notably schwertmannite and jarosite, may be important components; (3) In an attempt to better understand the causes of complexities in mixing relationships, the possible influence of sedimentary transport has been evaluated; (4) Another aspect of this research has been to examine the possibility of sedimentary silica being a significant phase on Mars; and (5) On Earth, the geochemistry of sedimentary rocks has been used to constrain the chemical composition of the continental crust and an important part of this research was to evaluate this approach for Mars.
Derived from text
*Geochemistry; Sedimentary Rocks; Mars Surface; Mars Surface Samples*

**20020020177** NASA Goddard Space Flight Center, Greenbelt, MD USA
**The Annual Cycle of Water Vapor on Mars as Observed by the Thermal Emission Spectrometer**
Smith, Michael D., NASA Goddard Space Flight Center, USA; [2001]; 32p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Spectra taken by the Mars Global Surveyor Thermal Emission Spectrometer (TES) have been used to monitor the latitude, longitude, and seasonal dependence of water vapor for over one full Martian year (March 1999-March 2001). A maximum in water

vapor abundance is observed at high latitudes during mid-summer in both hemispheres, reaching a maximum value of approximately 100 pr-micrometer in the north and approximately 50 pr-micrometer in the south. Low water vapor abundance (is less than 5 pr-micrometer) is observed at middle and high latitudes in the fall and winter of both hemispheres. There are large differences in the hemispheric (north versus south) and seasonal (perihelion versus aphelion) behavior of water vapor. The latitudinal and seasonal dependence of the decay of the northern summer water vapor maximum implies cross-equatorial transport of water to the southern hemisphere, while there is little or no corresponding transport during the decay of the southern hemisphere summer maximum. The latitude-longitude dependence of annually-averaged water vapor (corrected for topography) has a significant positive correlation with albedo and significant negative correlations with thermal inertia and surface pressure. Comparison of TES results with those retrieved from the Viking Orbiter Mars Atmospheric Water Detectors (MAWD) experiments shows some similar features, but also many significant differences. The southern hemisphere maximum observed by TES was not observed by MAWD and the large latitudinal gradient in annually-averaged water vapor observed by MAWD does not appear in the TES results.
Author
*Mars Atmosphere; Thermal Emission; Water Vapor; Annual Variations*

**20020020648** State Univ. of New York, Dept. of Geosciences, Stony Brook, NY USA
**Crustal Heat Production and the Thermal Evolution of Mars**
McLennan, Scott M., State Univ. of New York, USA; Geophysical Research Letters; Nov. 01, 2001; ISSN 0094-8276; Volume 28, No. 21, pp. 4019-4022; In English
Contract(s)/Grant(s): NAG5-8169; NAG5-10583
Report No.(s): Paper-2001GL01343; Copyright; Avail: Issuing Activity
The chemical composition of soils and rocks from the Pathfinder site and Phobos-2 orbital gamma-ray spectroscopy indicate that the Martian crust has a bulk composition equivalent to large-ion lithophile (LIL) and heat-producing element (K, Th, U) enriched basalt, with a potassium content of about 0.5%. A variety of radiogenic isotope data also suggest that separation of LIL-enriched crust and depleted mantle reservoirs took place very early in Martian history (>4.0 Ga). Accordingly, if the enriched Martian crust is is greater than 30 km thick it is likely that a large fraction (up to at least 50%) of the heat-producing elements in Mars was transferred into the crust very early in the planet's history. This would greatly diminish the possibility of early widespread melting of the Martian mantle.
Author
*Chemical Composition; Mars Surface; Planetary Crusts; Planetary Geology; Planetary Mantles*

**20020021287** Proxemy Research, Inc., Laytonsville, MD USA
**Volcanic Plumes on Io and Mars** ***Quarterly Report, 1 Oct. - 31 Dec. 2001***
Glaze, Lori S., Proxemy Research, Inc., USA; Dec. 31, 2001; 44p; In English
Contract(s)/Grant(s): NASW-00013
Report No.(s): IO-101-004; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Proxemy research is under contract to NASA to perform science research of volcanic plumes on Mars and Io. This report is submitted in accordance with contract NASW-00013 and contains a summary of activities. In addition to a synopsis of science research conducted, any manuscripts submitted for publication in this time period are also attached. Abstracts to scientific conferences may also be included if appropriate.
Author
*Io; Plumes; Mars (Planet); Volcanoes; Planetary Geology*

## 92
## SOLAR PHYSICS

*Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.*

**20020016395** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Investigation of the Relative Value of Solar Proxies for Irradiance Variation**
Jordan, Stuart, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English, 21-30 Sep. 2001, Naples, Italy; No Copyright; Avail: Issuing Activity; Abstract Only
Recent space observations of irradiance change during the current solar cycle 23 suggest that of the three proxies currently used (PSI index, total solar magnetic field, and the Mg II c/w index) only the latter yields a consistent result when compared to

the two previous cycles for which space observations are available. Possible reasons for this are presented, and a case is made that using actual sunspot areas might work almost as well as the PSI index for estimating irradiance changes, making earlier observations lacking photometric calibration of value in assessing probable irradiance changes over earlier sunspot cycles.
Author
*Evaluation; Solar Radiation; Irradiance; Change Detection; Sunspot Cycle*

**20020016493** NASA Goddard Space Flight Center, Greenbelt, MD USA
**Early X-Ray Imaging Spectroscopy Results from HESSI**
Dennis, Brian R., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; HESSI Data Analysis Workshop, Zurich, HI, Switzerland, USA; No Copyright; Avail: Issuing Activity; Abstract Only

First results from HESSI will be presented. Several flares will be selected for analysis. Images with the finest possible resolution up to 2 arcseconds will be displayed as a function of time in different energy bands from below 10 keV to above 100 keV. The relation between the soft and hard X-ray time profiles will be investigated with the objective of searching for the spatial Neupert effect, where the hard X-ray profile for any region of the source is similar to the time differential of the soft X-ray profile.
Author
*X Ray Imagery; Data Acquisition; Spectroscopy*

**20020017694** Swales Aerospace, Golden, CO USA
**Solar-B EIS Filter Molecular Contamination Analysis**
Gordon, Tim, Swales Aerospace, USA; Aug. 30, 2001; 25p; In English
Report No.(s): EIS-Prog-Report27-Rev-3; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this analysis is to determine the contaminant deposition on the filters in the EIS during the Solar B mission life. The EIS is a sun-viewing instrument on the Solar B spacecraft that will be positioned in a solar inertial orbit. The filters will be in constant exposure to the entire solar spectrum, including solar UV, consequently photodeposition of contaminants is a critical concern. The Solar B spacecraft geometry has been reduced to a geometry model containing critical components necessary for the contamination analysis. Some modeling parameters such as molecular source functions have been estimated based on the modeler's experience with similar spacecraft. For parameters which have been estimated, justification for the values used is discussed in the following text. As more information becomes available in the future, one or more of the estimated modeling parameters may need to be adjusted to better predict the contamination environment for EIS on the Solar B spacecraft. This report describes the third iteration of the external contamination analysis for the EIS. It includes more accurate input parameters which were added as information became available. Also, the geometry has been expanded to include the XRT and FPP. A thruster effluent analysis was performed and is included along with a discussion of the effects of the thermal radiators.
Author
*Solar Orbits; Contamination; Descriptive Geometry; Solar Energy Absorbers*

**20020018566** NASA Marshall Space Flight Center, Huntsville, AL USA
**Internal and External Reconnection Series Homologous Solar Flares**
Sterling, Alphonse C., National Academy of Sciences - National Research Council, USA; Moore, Ronald L., NASA Marshall Space Flight Center, USA; Journal of Geophysical Research; Nov. 01, 2001; ISSN 0148-0227; Volume 106, No. A11, pp. 25,227-25,238; In English
Report No.(s): Paper-2000JA004001; Copyright; Avail: Issuing Activity

Using data from the extreme ultraviolet imaging telescope (EIT) on SOHO and the soft X-ray telescope (SXT) on Yohkoh, we examine a series of morphologically homologous solar flares occurring in National Oceanic and Atmospheric Administration (NOAA) active region 8210 over May 1-2, 1998. An emerging flux region (EFR) impacted against a sunspot to the west and next to a coronal hole to the east is the source of the repeated flaring. An SXT sigmoid parallels the EFR's neutral line at the site of the initial flaring in soft X rays. In EIT each flaring episode begins with the formation of a crinkle pattern external to the EFR. These EIT crinkles move out from, and then in toward, the EFR with velocities approx. 20 km/ s. A shrinking and expansion of the width of the coronal hole coincides with the crinkle activity, and generation and evolution of a postflare loop system begins near the time of crinkle formation. Using a schematic based on magnetograms of the region, we suggest that these observations are consistent with the standard reconnection-based model for solar eruptions but are modified by the presence of the additional magnetic fields of the sunspot and coronal hole. In the schematic, internal reconnection begins inside of the EFR-associated fields, unleashing a flare, postflare loops, and a coronal mass ejection (CME). External reconnection, first occurring between the escaping CME and the coronal hole field and second occurring between fields formed as a result of the first external reconnection, results in the EIT crinkles and changes in the coronal hole boundary. by the end of the second external reconnection, the initial

setup is reinstated; thus the sequence can repeat, resulting in morphologically homologous eruptions. Our inferred magnetic topology is similar to that suggested in the ”breakout model” of eruptions although we cannot determine if our eruptions are released primarily by the breakout mechanism (external reconnection) or, alternatively, primarily by the internal reconnection. Author

*Solar Flares; Morphology; Coronal Holes; Imaging Techniques; Magnetic Signatures; Sunspots*

**20020019228** NASA Marshall Space Flight Center, Huntsville, AL USA

**A Prospective Method for Predicting Coronal Mass Ejections From Vector Magnetograms**

Falconer, D. A., NASA Marshall Space Flight Center, USA; Journal of Geophysical Research; Nov. 01, 2001; ISSN 0148-0227; Volume 106, No. A11, pp. 25,185-25,190; In English

Report No.(s): Paper-2000JA004005; Copyright; Avail: Issuing Activity

Two quantitative measures of the global nonpotentiality of predominantly bipolar active regions are explored for their usefulness as indicators of whether an active region is likely to produce coronal mass ejections (CMEs). The two measures, length of strong-field strong-shear main neutral line (Lss) and global net current (IN), are obtained directly from vector magnetograms of the regions. From measurements of Lss and IN in four active regions for which the global nonpotentiality and CME productivity are assessed independently of Lss and IN, it appears that Lss and IN are each a useful indicator of an active region’s likely CME productivity. The results also suggest that Lss and IN may be more reliable predictors of the CME productivity of active regions than is the presence or absence of sigmoidal structure in coronal X-ray images of the regions and that there might be threshold values of Lss and IN above which CME production is likely and below which CME production is unlikely. While these results need to be certified by an expansion of this pilot study to more active regions, they show the promise of Lss and IN as quantitative measures of global nonpotentiality for CME prediction.

Author

*Stellar Mass Ejection; Magnetic Signatures; X Ray Imagery; Vectors (Mathematics)*

**20020019230** NASA Ames Research Center, Moffett Field, CA USA

**Shock Excursion Due to Fluctuations in the Solar Wind Upstream Conditions**

Ratkiewicz, Romana E., NASA Ames Research Center, USA; Barnes, A., NASA Ames Research Center, USA; Molvik, G. A., NASA Ames Research Center, USA; Spreiter, J. R., Stanford Univ., USA; Stahara, S. S., RMA Aerospace, Inc., USA; [1994]; 1p; In English; EGS 20th General Assembly, 3-7 Apr. 1995, Hamburg, Germany; Sponsored by European Geophysical Society, Unknown

Contract(s)/Grant(s): RTOP 370-24-42-10; No Copyright; Avail: Issuing Activity; Abstract Only

Large-scale fluctuations in the solar wind upstream of the termination shock will cause inward and outward motions of the shock. In earlier work, Barnes analyzed such motion by calculating of the response of a planar gasdynamic shock to upstream disturbances. We now generalize this analysis to the case of a spherically symmetric shock. Our procedure is first to solve numerically the set of gasdynamic equations describing the interaction between the solar wind and the interstellar medium to establish a dynamic equilibrium. The next step is to impose upstream fluctuations of the solar wind dynamical pressure on this equilibrium state at an inner boundary, and then to follow the subsequent shock motion.

Author

*Shock Waves; Solar Wind; Upstream; Gas Dynamics*

**20020020178** NASA Marshall Space Flight Center, Huntsville, AL USA

**Correlation of the CME Productivity of Solar Active Regions with Measures of their Global Nonpotentiality from Vector Magnetograms: Baseline Results**

Falconer, David A., Alabama Univ., USA; Moore, Ron L., NASA Marshall Space Flight Center, USA; Gary, G. Allen, NASA Marshall Space Flight Center, USA; [2001]; 2p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

From conventional magnetograms and chromospheric and coronal images, it is known qualitatively that the fastest coronal mass ejections (CMEs) are magnetic explosions from sunspot active regions in which the magnetic field is globally strongly sheared and twisted from its minimum-energy potential configuration. In this paper, we present measurements from active-region vector magnetograms that begin to quantify the dependence of the CME productivity of an active region on the global nonpotentiality of its magnetic field. From each of 17 magnetograms of 12 bipolar active regions, we obtain a measure of the size of the active region (the magnetic flux content, phi) and three different measures of the global nonpotentiality (L(sub SS), the

length of strong-shear, strong-field main neutral line; I(sub N), the net electric current arching from one polarity to the other; and alpha = muI(subN/phi), a flux-normalized measure of the field twist).
Author
*Magnetic Signatures; Coronal Mass Ejection; Vectors (Mathematics); Solar Corona; Magnetic Fields*

**20020020659** NASA Marshall Space Flight Center, Huntsville, AL USA
**H(alpha) Proxies for EIT Crinkles: Further Evidence for Preflare "Breakout"-Type Activity in an Ejective Solar Eruption**
Sterling, Alphonse C., National Academy of Sciences - National Research Council, USA; Qiu, Jiong, New Jersey Inst. of Tech., USA; Wang, Haimin, New Jersey Inst. of Tech., USA; Moore, Ronald L., NASA Marshall Space Flight Center, USA; Astrophysical Journal; Nov. 10, 2001; Volume 561, pp. 1116-1126; In English
Contract(s)/Grant(s): NSF ATM-99-03515; NSF ATM-00-76602; Copyright; Avail: Issuing Activity

We present H(alpha) observations from Big Bear Solar Observatory of an eruptive flare in NOAA Active Region 8210, occurring near 22:30 UT on 1998 May 1. Previously, using the Extreme Ultraviolet Imaging Telescope (EIT) on the Solar and Heliospheric Observatory (SOHO) spacecraft, we found that a pattern of transient, localized brightenings, which we call 'EIT crinkles,' appears in the neighborhood of the eruption near the time of flare onset. These EIT crinkles occur at a location in the active region well separated from the sheared core magnetic fields, which is where the most intense features of the eruption are concentrated. We also previously found that high-cadence images from the Soft X-ray Telescope (SXT) on Yohkoh indicate that soft X-ray intensity enhancements in the core begin after the start of the EIT crinkles. With the H(alpha) data, we find remote flare brightening counterparts to the EIT crinkles. Light curves as functions of time of various areas of the active region show that several of the remote flare brightenings undergo intensity increases prior to the onset of principal brightenings in the core region, consistent with our earlier findings from EIT and SXT data. These timing relationships are consistent with the eruption onset mechanism known as the breakout model, introduced by Antiochos and colleagues, which proposes that eruptions begin with reconnection at a magnetic null high above the core region. Our observations are also consistent with other proposed mechanisms that do not involve early reconnection in the core region. As a corollary, our observations are not consistent with the so-called tether-cutting models, which say that the eruption begins with reconnection in the core. The H(alpha) data further show that a filament in the core region becomes activated near the time of EIT crinkle onset, but little if any of the filament actually erupts, despite the presence of a halo coronal mass ejection (CME) associated with this event.
Author
*Solar Flares; Ultraviolet Astronomy; Solar Corona; Chromosphere; Solar Prominences*

## 93
## SPACE RADIATION

*Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see 52 Aerospace Medicine. For theory see 73 Nuclear Physics.*

**20020016247** Los Alamos National Lab., NM USA
**New Calculation of Radioactive Secondaries in Cosmic Rays**
Moskalenko, I. V.; Mashnik, S. G.; Strong, A. W.; Jun. 01, 2001; 5p; In English
Report No.(s): DE2001-783154; LA-UR-01-2982; No Copyright; Avail: Department of Energy Information Bridge

We use a new version of our numerical model for particle propagation in the galaxy to study radioactive secondaries. For evaluation of the production cross sections we use the Los Alamos compilation of all available experimental cross sections together with calculations using the improved Cascade-Exciton Model code CEM2k. Using the radioactive secondary ratios Al-26/Al-27, CL-36/Cl, Mn-54/Mn, we show how the improved cross-section calculations together with the new propagation code allow us to better constrain the size of the cosmic ray halo.
NTIS
*Cosmic Rays; Mathematical Models; Isotope Ratios*

**20020016467** NASA Goddard Space Flight Center, Greenbelt, MD USA
**High Resolution Radio Imaging of the Merging Galaxies NGC3256 and NGC4194**
Neff, S. G., NASA Goddard Space Flight Center, USA; Campion, S. D., Science Systems and Applications, Inc., USA; Ulvestad, J. S., National Radio Astronomy Observatory; [2001]; 1p; In English; AAS 199th Conference, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

We present new 6cm and 4cm radio continuum images of the central regions of the merging galaxy systems NGC3256 and NGC4194. NGC3256 is imaged with a resolution of approx. 1 in. or approx. 190pc; NGC4194 is imaged with a resolution of approx. 0.3 in. or approx. 50pc. In both systems, we detect numerous compact radio sources embedded in more diffuse radio emission. We detect 65 compact sources in NGC3256 at 6cm and we detect 46 compact sources in NGC4194, both to a limiting luminosity of approx. 5 x 10(exp 18) W/ Hz or approx. 5 times the luminosity of Cas A. Most of the compact radio sources are loosely associated with active star forming regions but not with specific optical emission sources. Several compact radio sources in NGC3256 are near positions of compact X-ray sources detected by Lira et al.. In both NGC3256 and NGC4194, we are able to measure reliable spectral indices for the stronger sources. We find in NGC3256 approx. 20% have nominally flat radio spectral indices (indicating they are dominated by thermal radio emission from HII regions) while approx. 80% have nominally steep spectral indices (indicating they are dominated by nonthermal emission from supernova remnants). In NGC4194, half the compact radio sources have flat spectral indices and half have steep indices. For the flat-spectrum sources, we estimate the number of young massive stars and the associated ionized gas masses. For the steep-spectrum sources, we estimate supernova rates. We compare these results with those from other well-studied merging galaxy systems. We gratefully acknowledge use of the NRAO Very Large Array (VLA) and the VLA Archive. NRAO is a facility of the National Science Foundation, operated under cooperative agreement by Associated Universities, Inc.

Author

*X Ray Sources; Very Large Array (VLA); Thermal Emission; Imaging Techniques; Radio Emission; Galaxies*

**20020016498** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Observing the Cosmic Microwave Background Radiation: A Unique Window on the Early Universe**

Hinshaw, Gary, NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; AAS 199th Conference, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The cosmic microwave background radiation is the remnant heat from the Big Bang. It provides us with a unique probe of conditions in the early universe, long before any organized structures had yet formed. The anisotropy in the radiation's brightness yields important clues about primordial structure and additionally provides a wealth of information about the physics,of the early universe. Within the framework of inflationary dark matter models observations of the anisotropy on sub-degree angular scales will reveal the signatures of acoustic oscillations of the photon-baryon fluid at a redshift of approx. 1100. The validity of inflationary models will be tested and, if agreement is found, accurate values for most of the key cosmological parameters will result. If disagreement is found, we will need to rethink our basic ideas about the physics of the early universe. I will present an overview of the physical processes at work in forming the anisotropy and discuss what we have already learned from current observations. I will conclude with a brief overview of the recently launched Microwave Anisotropy Probe (MAP) mission which will observe the anisotropy over the full sky with 0.21 degree angular resolution. At the time of this meeting, MAP will have just arrived at the L2 Lagrange point, marking the start of its observing campaign. The MAP hardware is being produced by Goddard in partnership with Princeton University.

Author

*Astronomical Models; Cosmic Microwave Background Radiation; Microwaves; Sound Waves; Red Shift; Photons*

**20020017251** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Fe(+) Emission from Eta Carinae B and D Blobs: Theory and HST Observations**

Verner, E., NASA Goddard Space Flight Center, USA; Gull, Theodore R., NASA Goddard Space Flight Center, USA; Ishibashi, B., NASA Goddard Space Flight Center, USA; Bruhweiler, F., NASA Goddard Space Flight Center, USA; Ferland, G., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; 199th American Astronomical Society Meeting, 6-10 Jan. 2002, Washington, DC, USA; Sponsored by American Astronomical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

We present comparisons between numerical simulations of Fe II emission spectra and HST high-resolution and signal-to-noise spectra of the Eta Carinae Weigelt B & D blobs. The spectra show a wealth of FeII and [FeII] lines. We investigate the dependence of the spectrum on electron density and on pumping by blackbody radiation. Using the photoionization code Cloudy we were able successfully reproduce the fluxes of few hundred FeII & [Fe II] lines in the range from 4000A to 6000A. Fe II emission analysis in Eta Car ejecta is very important because it provides information about excitation conditions, the electron temperature and density solved in a selfconsistent way. Moreover, for the first time we were able to use Fe II emission analysis itself to put limits on CNO abundances in emitting regions.

Author

*Abundance; Black Body Radiation; Iron; Hubble Space Telescope; Emission Spectra; Simulation*

**20020017695** Stanford Linear Accelerator Center, Stanford, CA USA
**Prompt Signals of Gamma Ray Bursts**
Chen, P.; Sep. 18, 2001; 11p; In English
Report No.(s): DE2001-787224; SLAC-PUB-8874; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We introduce a new model of gamma ray burst (GRB) that explains its observed prompt signals, namely, its primary thermal spectrum and high energy tail. This mechanism can be applied to either assumption of GRB progenitor: coalescence of compact objects or hypernova explosion.
NTIS
*Gamma Ray Bursts; Spectra; Thermal Energy*

**20020018195** Stanford Linear Accelerator Center, Stanford, CA USA
**Predicting Neutron Production from Cosmic-Ray Muons**
Fasso, A.; Aug. 29, 2001; 8p; In English
Report No.(s): DE2001-787227; SLAC-PUB-8939; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Fast neutrons from cosmic-ray muons are an important background to underground low energy experiments. The estimate of such background is often hampered by the difficulty of measuring and calculating neutron production with sufficient accuracy. Indeed substantial disagreement exists between the different analytical calculations performed so far, while data reported by different experiments is not always consistent. We discuss a new unified approach to estimate the neutron yield, the energy spectrum, the multiplicity, and the angular distribution from cosmic muons using the Monte Carlo simulation package FLUKA and show it gives a good description of most of the existing measurements once the appropriate corrections have been applied.
NTIS
*Angular Distribution; Computerized Simulation; Cosmic Rays; Fast Neutrons; Muons*

**20020018839** Stanford Linear Accelerator Center, CA USA
**Distributions of Secondary Muons at Sea Level from Cosmic Gamma Rays Below 10 TeV**
Roesler, S.; Jul. 31, 2001; 37p; In English
Report No.(s): DE2001-787214; SLAC-PUB-8945; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The FLUKA Monte Carlo program is used to predict the distributions of the muons which originate from primary cosmic gamma rays and reach sea level. The main result is the angular distribution of muons produced by vertical gamma rays which is necessary to predict the inherent angular resolution of any instrument utilizing muons to infer properties of gamma ray primaries. Furthermore, various physical effects are discussed which affect these distributions in differing proportions.
NTIS
*Gamma Rays; Muons; Primary Cosmic Rays; Sea Level; Monte Carlo Method*

**20020020174** Space Telescope Science Inst., Baltimore, MD USA
**Search for the Cosmic Infrared Background Radiation using COBE Data** ***Final Report, 1 Feb. 1997 - 31 Jan. 2001***
Hauser, Michael, Space Telescope Science Inst., USA; [2001]; 3p; In English
Contract(s)/Grant(s): NAG5-3899; STScI Proj. J0547; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
This project was initiated to allow completion of the primary investigation of the Diffuse Infrared Background Experiment (DIRBE) on NASA's Cosmic Background Explorer (CORE) mission, and to study the implications of those findings. The Principal Investigator (PI) on this grant was also the Principal Investigator on the DIRBE team. The project had two specific goals: Goal 1: Seek improved limits upon, or detections of, the cosmic infrared background radiation using data from the COBE Diffuse Infrared Background Experiment (DIRBE). Goal 2: Explore the implications of the limits and measured values of the cosmic infrared background for energy releases in the Universe since the formation of the first luminous sources. Both of these goals have been successfully accomplished.
Derived from text
*Cosmic Background Explorer Satellite; Infrared Radiation; Data Acquisition; Astrophysics*

**20020020365** NASA Marshall Space Flight Center, Huntsville, AL USA
**BATSE Observations of Gamma-Ray Burst Tails**
Connaughton, Valerie, NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only
With the discovery of low-energy radiation appearing to come from the site of gamma-ray bursts in the hours to weeks after the initial burst of gamma rays, it would appear that astronomers have seen a cosmological imprint made by the burster on its

surroundings. I discuss in this paper the phenomenon of post-burst emission in BATSE (Burst and Transient Source Experiment) gamma-ray bursts at energies traditionally associated with prompt emission. by summing the background-subtracted signals from hundreds of bursts, I find that tails out to hundreds of seconds after the trigger may be a common feature of long events (duration greater than 2s), and perhaps of the shorter bursts at a lower and shorter-lived level. The tail component appears independent of both the duration (within the long GRB sample) and brightness of the prompt burst emission, and may be softer. Some individual bursts have visible tails at gamma-ray energies and the spectrum in at least a few cases is different from that of the prompt emission. Afterglow at lower energies was detected for one of these bursts, GRB-991216, raising the possibility of afterglow observations over large energy ranges using the next generation of GRB detectors in conjunction with sensitive space or ground-based telescopes.
Author
*Gamma Ray Bursts; Gamma Ray Observatory*

**20020020472** Argonne National Lab., IL USA
**Cosmic ray sun shadow in Soudan 2 underground muon flux**
Allison, W. W. M.; Alner, G. J.; Ayres, D. S.; Barrett, W. L.; Bode, C.; Jun. 23, 1999; 6p; In English
Report No.(s): DE2001-11873; ANL-HEP-CP-99-60; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The absorption of cosmic rays by the sun produces a shadow at the earth. The angular offset and broadening of the shadow are determined by the magnitude and structure of the interplanetary magnetic field (IPMF) in the inner solar system. The authors report the first measurement of the solar cosmic ray shadow by detection of deep underground muon flux in observations made during the entire ten-year interval 1989 to 1998. The sun shadow varies significantly during this time, with a 3.3(sigma) shadow observed during the years 1995 to 1998.
NTIS
*Cosmic Rays; Sun; Interplanetary Magnetic Fields*

**20020020660** NASA Marshall Space Flight Center, Huntsville, AL USA
**Multiwavelength Observations of the Soft Gamma Repeater SGR 1900+14 During Its 2001 April Activation**
Kouveliotou, C., Universities Space Research Association, USA; Tennant, A., NASA Marshall Space Flight Center, USA; Woods, P. M., Universities Space Research Association, USA; Weisskopf, M. C., NASA Marshall Space Flight Center, USA; Hurley, K., California Univ., USA; Fender, R. P., Astronomical Inst., Netherlands; Garrington, S. T., Manchester Univ., UK; Patel, S. K., Universities Space Research Association, USA; Goegues, E., Alabama Univ., USA; Astrophysical Journal; Sep. 01, 2001; Volume 558, pp. L47-L50; In English
Contract(s)/Grant(s): JPL-958056; NAG5-9350; MX-0101; GO0-1018X; Copyright; Avail: Issuing Activity

The soft gamma repeater SGR 1900+14 became active on 2001 April 18 after about two years of quiescence; it had remained at a very low state of activity since the fall of 1998, when it exhibited extraordinary flaring. We have observed the source in the gamma-rays and X-rays with Ulysses and Chandra and in the radio with MERLIN. We report here the confirmation of a two-component X-ray spectrum (power law and blackbody), indicating emission from the neutron star surface. We have determined that there is a dust halo, due to scattering in the interstellar medium, surrounding the source that extends up to approximately 100 arcsec from the center of SGR 1900+14.
Author
*Gamma Ray Astronomy; Stellar Magnetic Fields; Soft Gamma Repeaters; Spectrum Analysis*

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## GENERAL

*Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.*

**20020018629** Southampton Univ., UK
**Institute of Sound and Vibration Research *Annual Report, May 2000 - Apr. 2001***
2001; 108p; In English; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The main body of this report inclusively covers the Period from May 2000 to April 2001. This material includes descriptions of the activities and work of the four research groups and two consultancy units, ICS and ADAU. The report of the Hearing and

Balance Centre, which covers the work of the South of England Cochlear Implant Centre, as well as audiological research, is included in the report of the Human Sciences Group. In conformity with the University procedure, publications listed at the end of the respective sections, and the summary of publication statistics in Appendix 5, cover the calendar year 2000. The list of academic awards (Appendix 1) covers the conferment of doctorates awarded at various times during the academic session September 2000 to July 2001, as well as Masters and Diploma awards and First Degrees awarded in July 2001.
Derived from text
*Research Projects; Audiology; Acoustics; Structural Vibration*

**20020019071** Advisory Group for Aeronautical Research and Development, Paris, France
**AGARD: The History, 1952-1997**
vanderBliek, Jan, Editor; Jul. 2001; 217p; In English
Report No.(s): AD-A396959; ISBN 92-836-1080-6; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
This book may be considered as a tribute to the works of Theodore Von Karman and Frank Wattendorf, his close associate and first Director of AGARD. Dr. von Karman (1881-1963), a well know aeronautical scientist with friends in many countries, was intensely interested in international scientific cooperation. Soon after NATO was established in 1949, he conceived the idea of an Advisory Group for Aeronautical Research and Development (AGARD) under the umbrella of NATO, and he succeeded in starting it as a group of NATO early in 1952. It became the first scientific agency of NATO. As the first Chairman of this NATO Agency, he developed a unique structure of technical-scientific Panels composed of scientists and engineers from the NATO countries who exchanged information, organized meetings, produced thousands of timely high quality publications, carried out joint projects, organized study groups for the NATO military Committee and assisted each other in developing their research and development capabilities. AGARD grew to an organization with over 500 Panel members and some 1300 people contributed annually to lectures, in working groups, in study teams, etc. In 1997, forty-five years after its formation, AGARD was amalgamated with the Defence Research Group (DRG) to form the Research and Technology Organization (RTO). The book records the deliberations of the AGARD National Delegates Board and aspects of the work of the Aerospace Applications Studies Committee and of the Technical Panels which constituted the main activity of AGARD.
DTIC
*Aerospace Engineering; Histories*

**20020020598** NASA Marshall Space Flight Center, Huntsville, AL USA
**Absorbed Dose Determination Using Experimental and Analytical Predictions of X-Ray Spectra**
Edwards, D. L., NASA Marshall Space Flight Center, USA; November 2001; 1p; In English
Report No.(s): NASA/TM-2001-211383; NAS 1.15:211383; M-1033; No Copyright; Avail: Issuing Activity; Abstract Only
Electron beam welding in a vacuum is a technology that NASA is investigating as a joining technique for manufacture of space structures. This investigation characterizes the x-ray environment due to operation of an in-vacuum electron beam welding tool and provides recommendations for adequate shielding for astronauts performing the in-vacuum electron beam welding. NASA, in a joint venture with the Russian Space Agency, was scheduled to perform a series of welding in space experiments on board the U.S. Space Shuttle. This series of experiments was named the international space welding experiment (ISWE). The hardware associated with the ISWE was leased to NASA by the Paton Welding Institute (PWI) in Ukraine for ground-based welding experiments in preparation for flight. Two ground tests were scheduled, using the ISWE electron beam welding tool, to characterize the radiation exposure to an astronaut during the operation of the ISWE. These radiation exposure tests used thermoluminescence dosimeters (TLD's) shielded with material currently used by astronauts during extravehicular activities to measure the radiation dose. The TLD's were exposed to x-ray radiation generated by operation of the ISWE in-vacuum electron beam welding tool. This investigation was the first known application of TLD's to measure absorbed dose from x rays of energy less than 10 keV. The ISWE hardware was returned to Ukraine before the issue of adequate shielding for the astronauts was completely verified. Therefore, alternate experimental and analytical methods were developed to measure and predict the x-ray spectral and intensity distribution generated by ISWE electron beam impact with metal. These x-ray spectra were normalized to an equivalent ISWE exposure, then used to calculate the absorbed radiation dose to astronauts. These absorbed dose values were compared to TLD measurements obtained during actual operation of the ISWE in-vacuum electron beam welding tool. The calculated absorbed dose values were found to be in agreement with the measured TLD values.
Author
*Dosage; Electron Beam Welding; Spacecraft Structures; Vacuum; X Ray Spectra; Thermoluminescence*

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