



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

**Scientific and Technical  
Information Program Office**

# **Scientific and Technical Aerospace Reports**

# STAIR

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## NASA STI Program ... in Profile

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The NASA STI program operates under the auspices of the Agency Chief Information Officer. It collects, organizes, provides for archiving, and disseminates NASA's STI. The NASA STI program provides access to the NASA Aeronautics and Space Database and its public interface, the NASA Technical Report Server, thus providing one of the largest collections of aeronautical and space science STI in the world. Results are published in both non-NASA channels and by NASA in the NASA STI Report Series, which includes the following report types:

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- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
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- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

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- Fax your question to the NASA STI Help Desk at (301) 621-0134
- Phone the NASA STI Help Desk at (301) 621-0390
- Write to:  
NASA STI Help Desk  
NASA Center for AeroSpace Information  
7115 Standard Drive  
Hanover, MD 21076-1320

# Introduction

*Scientific and Technical Aerospace Reports (STAR)* is an online information resource listing citations and abstracts of NASA and worldwide aerospace-related scientific and technical information (STI). Updated biweekly, *STAR* highlights the most recent additions to the NASA Aeronautics and Space Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related research and development (R&D) results.

*STAR* subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

*STAR* includes citations to R&D results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

## The NASA STI Program

The NASA STI Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces, and disseminates both NASA's internal STI and worldwide STI. The results of 20th and 21st century aeronautics and aerospace research and development, a worldwide investment totaling billions of dollars, have been captured, organized, and stored in the NASA Aeronautics and Space Database. New information is continually announced and made available as it is acquired, making this a dynamic and historical collection of value to business, industry, academia, federal institutions, and the general public.

The STI Program offers products and tools that allow efficient access to the wealth of information derived from global R&D efforts. In addition, customized services are available to help tailor this valuable resource to meet your specific needs.

For more information on the most up-to-date NASA STI, visit the STI Program's Web site at <http://www.sti.nasa.gov>.

# NASA STI Availability Information

## NASA Center for AeroSpace Information (CASI)

Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at [help@sti.nasa.gov](mailto:help@sti.nasa.gov). Others should visit the program at [www.sti.nasa.gov](http://www.sti.nasa.gov). The 'search selected databases' button provides access to the NASA Technical Reports Server (NTRS) – the publicly available contents of the NASA Aeronautics and Space Database.

Each citation in *STAR* indicates a 'Source of Availability.' When CASI is indicated, the user can order this information directly from CASI using the [STI Online Order Form](#), e-mail to [help@sti.nasa.gov](mailto:help@sti.nasa.gov), or telephone the STI Help Desk at 301-621-0390. Before ordering you may access [price code tables](#) for STI documents and videos. When information is not available from CASI, the source of the information is indicated when known.

NASA STI is also available to the public through Federal information organizations. NASA CASI disseminates publicly available NASA STI to the National Technical Information Service (NTIS) and to the Federal Depository Library Program (FDLP) through the Government Printing Office (GPO). In addition, NASA patents are available online from the U.S. Patent and Trademark Office.

## National Technical Information Service (NTIS)

The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at <http://www.ntis.gov>.

## The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** to ensure access for the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal depository libraries at <http://www.gpoaccess.gov/index.html>.

## The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at <http://www.uspto.gov/patft/>.

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[Personal Author Index](#)

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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VOLUME 45, NUMBER 8

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## 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 Thermodynamics.

**20070013939** Federal Aviation Administration, Cambridge, MA, USA

### **SFO Wake Turbulence Measurement System: Sensors and Data Descriptions**

Burnham, D. C.; Clark, K. L.; Hallock, J. N.; Hannon, S. M.; Jacobs, L. G.; Oct. 2006; 77 pp.; In English

Report No.(s): PB2007-107252; DOT/VNTSC-FAA-07-03; No Copyright; Avail.: National Technical Information Service (NTIS)

This report addresses aspects of an extensive aircraft wake turbulence measurement program conducted at San Francisco International Airport (SFO) over a two-year period. Specifically, this report describes the sensors used for data collection and the resulting data sets that were used for analysis of the Simultaneous Offset Instrument Approach (SOIA) procedure proposed for use at SFO. Three anemometer Windlines were deployed perpendicular to and between Runways 28L and 28R to measure and record wake vortex motion between the runways near the threshold and touchdown regions. Because Runways 28L and 28R are used for 80% of SFO arrivals, the SFO wake turbulence Windline dataset, comprising approximately 250,000 arrivals, is the largest ever accumulated. Pulsed Lidar wake measurements were made for approximately one month at a location where aircraft were approximately 500 feet above San Francisco Bay (about 9,000 feet from the thresholds). The ambient wind at 20 feet above ground was monitored on either side of the two runways, and a wind Sodar was used to measure wind profiles up to a height of 656 feet. Automated Surface Observation System (ASOS) winds at 33 feet above ground were also obtained.

NTIS

*Airports; Data Acquisition; Flow Measurement; San Francisco (CA); Turbulent Flow*

## 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; airport 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.

**20070013936** Texas Univ., El Paso, TX, USA

### **Performance Evaluation of HMA Consisting of Modified Asphalt Binder**

Sugandh, R.; Zea, M.; Tandon, V.; Smit, A.; Prozzi, J.; Feb. 2007; 122 pp.; In English

Report No.(s): PB2007-107250; REPT-0-4824-2; No Copyright; Avail.: National Technical Information Service (NTIS)

To achieve Strategic Highway Research Program (SHRP) specified PG grades, refineries make use of modifiers to enhance the properties of base asphalt. Even though modified binders may meet PG specifications, some perform better than others. This can be attributed to binder/hot mix asphalt (HMA) tests inability in consistently identifying the problems with the binders especially if the modifier is added to the binder. Therefore, it is necessary to identify a binder/HMA test that can consistently predict performance. The research performed for SHRP has significantly increased the understanding of HMA mix behavior among national and international highway-related agencies, which has resulted in an increase in the number of mixes available for placement. The increase in mix types makes it difficult for designers to select the appropriate mix for a given application. Therefore, it is necessary to have a HMA selection guideline. To achieve the objectives of this study, a survey was conducted to identify commonly placed mix and modifier types and logic followed in selection of mixes. Based



on survey results, three mixes (Type D, CMHB-C, and PFC) were selected. In addition, the four modifier types: SBS, SBR, TR, and Elvaloy were selected and evaluated. The evaluation results and recommendations are included in this report.  
NTIS

*Asphalt; Binders (Materials); Highways; Performance Tests*

## 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.

**20070013811** Honeywell International, Inc., Morristown, NJ, USA

#### **Heated Sub-Freezing Airflow Diverter**

McBride, J. W.; Murry, R. P.; Jensen, J. M.; 16 Apr 04; 18 pp.; In English

Contract(s)/Grant(s): LM-M4225

Patent Info.: Filed Filed 16 Apr 04; US-Patent-Appl-SN-10-826-011

Report No.(s): PB2007-105950; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A flow diverter comprises a heat sink array in fluid communication with a turbine outlet and an inlet face of a heat exchanger, the heat sink array comprising a plurality of heat sink elements, the heat sink array being separated from the inlet face by a distance, and the heat sink array being positioned between the turbine outlet and the inlet face such that at least a portion of a fluid flowing from the turbine outlet contacts the heat sink array before the portion of the fluid contacts the heat exchanger inlet face.

NTIS

*Air Flow; Diverters; Freezing; Heat Exchangers*

**20070013813** Honeywell International, Inc., Morristown, NJ, USA

#### **Turbomachine Compressor Scroll with Load-Carrying Inlet Vanes**

Smoke, J. C.; Frost, C.; Kocher, R. D.; Guymon, J. E.; Nguyen, L. D.; 20 Apr 04; 11 pp.; In English

Contract(s)/Grant(s): LM-N00019-01-C-3002

Patent Info.: Filed Filed 20 Apr 04; US-Patent-Appl-SN-10-829-114

Report No.(s): PB2007-105966; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A compressor scroll housing for use in conjunction with turbo-machinery, particularly applicable in aircraft. The scroll housing can include a plurality of scroll vanes arrayed around the scroll housing. Scroll vanes, integrally formed with the scroll housing, carry stress load on the scroll housing, including the load from fluid pressure within the scroll and carcass loading from the engine. The plurality of scroll vanes adapted for guiding flow of fluid from an inlet to an outlet while supporting the scroll housing. Chord length and cross sectional area of each scroll vane can be sized to maintain an equal stress in all scroll vanes. A method of making the scroll housing for use with an impeller connected to an engine is disclosed, as well as a method of operating turbo-machinery including supporting a load on the scroll housing with scroll vanes while maintaining an equal stress on each scroll vane.

NTIS

*Compressors; Loads (Forces); Vanes; Turbomachinery; Intake Systems*

**20070014685** Sandia National Labs., Albuquerque, NM USA

#### **Final Report on Development of Pulse Arrested Spark Discharge (PASD) for Aging Aircraft Wiring Application.**

Glover, S. F.; Lockner, T. R.; Howard, K. K.; Perna, E. G.; Schneider, L. X.; Sep. 01, 2006; 38 pp.; In English

Contract(s)/Grant(s): AC04-94AL85000

Report No.(s): DE2006-896561; SAND2005-2638; No Copyright; Avail.: Department of Energy Information Bridge

Pulsed Arrested Spark Discharge (PASD) is a Sandia National Laboratories Patented, non-destructive wiring system diagnostic that has been developed to detect defects in aging wiring systems in the commercial aircraft fleet. PASD was previously demonstrated on relatively controlled geometry wiring such as coaxial cables and shielded twisted-pair wiring through a contract with the U.S. navy and is discussed in a Sandia National Laboratories report, SAND2001-3225 'Pulsed Arrested Spark Discharge (PASD) Diagnostic Technique for the Location of Defects in Aging Wiring Systems'. This report describes an expansion of earlier work by applying the PASD technique to unshielded twisted-pair and discrete wire



configurations commonly found in commercial aircraft. This wiring is characterized by higher impedances as well as relatively non-uniform impedance profiles that have been found to be challenging for existing aircraft wiring diagnostics. Under a three year contract let by the Federal Aviation Administration, Interagency Agreement DTFA-03-00X90019, this technology was further developed for application on aging commercial aircraft wiring systems.

NTIS

*Electric Sparks; Electric Wire; Sparks; Wiring*

## 06

### AVIONICS AND AIRCRAFT INSTRUMENTATION

Includes all avionics systems, cockpit and cabin display devices, and flight instruments intended for use in aircraft. For related information see also 04 Aircraft Communications and Navigation; 08 Aircraft Stability and Control; 19 Spacecraft Instrumentation and Astrionics; and 35 Instrumentation and Photography.

**20070013821** General Electric Co., Schenectady, NY, USA

#### **Detection of Partial Discharge or Arcing in Wiring Via Fiber Optics**

Sarkozi, J. G.; Evers, N. A.; 23 Dec 03; 15 pp.; In English

Contract(s)/Grant(s): ONR-N00014-02-C-0402

Patent Info.: Filed Filed 23 Dec 03; US-Patent-Appl-SN-10-745 245

Report No.(s): PB2007-103092; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A cable, system and method for detecting partial discharges or arcing in wiring or cables via fiber optics are provided. The cable for detecting partial discharges includes a conductor for carrying electrical signals; at least one fluorescent optical fiber for detecting light generated by a partial discharge; and a first transparent layer surrounding the conductor for supporting the at least one fluorescent optical fiber generally parallel to the conductor. By employing a fluorescent optical fiber, incident light generated by a partial discharge along a length of the optical fiber will be transmitted via the optical fiber to an optical receiver for determining a partial discharge has occurred.

NTIS

*Electric Wire; Fault Detection; Fiber Optics; Nondestructive Tests; Wiring*

**20070013859** General Electric Co., Houston, TX, USA

#### **Current Transformers for Partial Discharge Detection on Aircraft Cables and Wires**

Sarkozi, J. G.; Evers, N. A.; 23 Dec 03; 7 pp.; In English

Contract(s)/Grant(s): N00014-02-C-0402

Patent Info.: Filed Filed 23 Dec 03; US-Patent-Appl-SN-10-745 141

Report No.(s): PB2007-103087; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A systems and methods are provided for detecting defects in aircraft wiring, and more particularly, for detecting partial discharges or arcing in wiring or cables. A high frequency current transformer (HFCT) is fixingly positioned in contact with a wire so that the wire is encircled by the HFCT. Partial discharges from a damaged wire so encircled will induce a current in the HFCT proportional to the current of the discharge. The HFCT comprises at least one conductive coil-like pattern formed onto a flexible insulating material, said insulating material having slits between each coil-turn of the coil-like pattern; and a core of flexible material fitted between the coil-turns through said slits.

NTIS

*Electric Wire; Fault Detection; High Frequencies; Nondestructive Tests; Transformers; Wire*

**20070013997** NASA Langley Research Center, Hampton, VA, USA

#### **Neutron Particle Effects on a Quad-Redundant Flight Control Computer**

Eure, Kenneth; Belcastro, Celeste M.; Gray, W Steven; Gonzalex, Oscar; Digital Avionics Systems Conference, 2003. The 22nd; 2003; Volume 1, pp. 1.B.2-1 - 1.B.2-8; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NCC1-03026; NSF CCR-0209094; DTFA03-96-X-90001; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/DASC.2003.1245806>

This paper describes a single-event upset experiment performed at the Los Alamos National Laboratory. A closed-loop control system consisting of a Quad-Redundant Flight Control Computer (FCC) and a B737 simulator was operated while the FCC was exposed to a neutron beam. The purpose of this test was to analyze the effects of neutron bombardment on avionics control systems operating at altitudes where neutron strikes are probable. The neutron energy spectrum produced at the Los

Alamos National Laboratory is similar in shape to the spectrum of atmospheric neutrons but much more intense. The higher intensity results in accelerated life tests that are representative of the actual neutron radiation that a FCC may receive over a period of years.

Author

*Flight Control; Airborne/Spaceborne Computers; Control Simulation; Neutron Beams; Energy Spectra; Avionics*

**20070014002** Old Dominion Univ., Norfolk, VA, USA

**Markov Jump-Linear Performance Models for Recoverable Flight Control Computers**

Zhang, Hong; Gray, W. Steven; Gonzalez, Oscar R.; Proceedings of the 36th IEEE Southeastern Symposium on System Theory; March 16, 2004, pp. 408-412; In English; 36th IEEE Southeastern Symposium on System Theory, 14-16 Mar. 2004, Atlanta, GA, USA

Contract(s)/Grant(s): NCC1-392; NCC1-03026; NSF CCR-0209094; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/SSST.2004.1295689>

Single event upsets in digital flight control hardware induced by atmospheric neutrons can reduce system performance and possibly introduce a safety hazard. One method currently under investigation to help mitigate the effects of these upsets is NASA Langley's Recoverable Computer System. In this paper, a Markov jump-linear model is developed for a recoverable flight control system, which will be validated using data from future experiments with simulated and real neutron environments. The method of tracking error analysis and the plan for the experiments are also described.

Author

*Airborne/Spaceborne Computers; Digital Systems; Flight Control; Single Event Upsets; Performance Prediction; Neutrons*

**07**

**AIRCRAFT PROPULSION AND POWER**

Includes primary propulsion systems and related systems and components, e.g., gas turbine engines, compressors, and fuel systems; 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.

**20070013829** Pratt and Whitney Aircraft Group, East Hartford, CT, USA

**Cooled Vane Cluster**

Coons, T.; Pietraszkiewicz, E.; 22 Dec 03; 11 pp.; In English

Contract(s)/Grant(s): N00019-02-C-3003

Patent Info.: Filed Filed 22 Dec 03; US-Patent-Appl-SN-10-743 516

Report No.(s): PB2007-103105; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A cast vane cluster with enhanced cooling contains an inner and an outer platform and at least two airfoils for directing a primary fluid stream axially rearward. A duct is bounded by inner, an outer endwall surfaces, and adjacent airfoil fluid directing surfaces. One or more cooling holes in the duct are drilled using an electrodischarge machine (EDM) method without a line of sight from the drilling equipment to the cooling hole location. One or more cooling holes, located in portions of the duct, may not be visible when viewed from an external location. Additionally, one or more cooling holes may only have an outlet cross sectional area visible when viewed along a longitudinal axis from an external location.

NTIS

*Alignment; Drilling; Openings; Turbines; Vanes; Cooling*

**20070013830** McCormick, Paulding and Huber, LLP, Hartford, CT, USA, United Technologies Corp., East Hartford, CT, USA

**Cooled Rotor Blade with Vibration Damping Device**

Gregg, S. J.; Mongillo, D. J.; 19 Dec 03; 8 pp.; In English

Patent Info.: Filed Filed 19 Dec 03; US-Patent-Appl-SN-10-741 106

Report No.(s): PB2007-103107; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A rotor blade for a rotor assembly is provided that includes a root, an airfoil, and a damper. The airfoil includes a base, a tip, a pressure side wall, a suction side wall, and a cavity disposed there-between. The cavity extends substantially between the base and the tip, and includes a first cavity portion, a second cavity portion, and a channel disposed between the first cavity portion and the second cavity portion. A plurality of first pedestals are disposed within the first cavity portion adjacent the

channel, and a plurality of second pedestals are disposed within the second cavity portion adjacent the channel. The damper is selectively received within the channel.

NTIS

*Vibration Damping; Cooling; Rotor Blades; Gas Turbine Engines*

**20070013866** McCormick, Paulding and Huber, LLP, Hartford, CT, USA, United Technologies Corp., East Hartford, CT, USA

**Cooled Rotor Blade with Vibration Damping Device (Pub No. US2005/0135935)**

Gregg, S. J.; 19 Dec 03; 8 pp.; In English

Patent Info.: Filed Filed 19 Dec 03; US-Patent-Appl-SN-10-741 103

Report No.(s): PB2007-103108; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A rotor blade for a rotor assembly is provided that includes a root, an airfoil, and a damper. The airfoil includes a base, a tip, a pressure side wall, a suction side wall, and at least one cavity disposed therebetween, and a channel. The damper is selectively received within the channel. The channel is disposed within the cavity between a first wall portion and a second wall portion. At least one of the first wall portion and the second wall portion includes a plurality of raised features extending outwardly from the wall into the channel. The features are spaced apart from one another. The raised features extend between the damper and the wall portion from which they extend outwardly. A plurality of tortuous flow passages are formed between the damper, the respective wall portion, and the raised features extending therebetween. Substantially all of the tortuous passages include at least one portion that extends at least partially in a lengthwise direction and at least one portion that extends at least partially in a widthwise direction.

NTIS

*Vibration Damping; Rotor Blades; Cooling; Mechanical Devices*

**20070013908** General Electric Co., Schenectady, NY, USA

**Hot gas path component with mesh and impingement cooling**

Bunker, R. S.; Lee, C. P.; 29 Jun 04; 12 pp.; In English

Contract(s)/Grant(s): DOD-PRDA VII F33615-02-C-2212

Patent Info.: Filed Filed 29 Jun 04; US-Patent-Appl-SN-10-881 506

Report No.(s): PB2007-102446; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A component includes at least one wall having an inner portion and an outer portion. A number of pins extend between the inner and outer portions. The pins define a mesh cooling arrangement with a number of flow channels. The inner portion of the wall defines a number of dimples. A method for forming a number of cooling holes in a component is described. The component has at least one wall with inner and outer portions. The inner portion defines a number of dimples. The method includes centering a drilling tool on a dimple, drilling at least one impingement cooling hole through the inner portion of the wall at the dimple using the drilling tool, and repeating the centering and drilling steps for a number of dimples to drill a number of impingement cooling holes in the inner portion of the wall.

NTIS

*Cooling; Gas Turbines; High Temperature Gases; Impingement*

**20070014605** Honeywell Engines, Systems and Services, Phoenix, AZ, USA

**Fuel Cell Auxiliary Power Study Volume 1: RASER Task Order 5**

Mak, Audie; Meier, John; February 2007; 132 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS3-01136; WBS 561581.02.08.03.06.01

Report No.(s): NASA/CR-2007-214461-VOL1; E-15725; 21-13153; No Copyright; Avail.: CASI: [A07](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014605>

This study evaluated the feasibility of a hybrid solid oxide fuel cell (SOFC) auxiliary power unit (APU) and the impact in a 90-passenger More-Electric Regional Jet application. The study established realistic hybrid SOFC APU system weight and system efficiencies, and evaluated the impact on the aircraft total weight, fuel burn, and emissions from the main engine and the APU during cruise, landing and take-off (LTO) cycle, and at the gate. Although the SOFC APU may be heavier than the current conventional APU, its weight disadvantage can be offset by fuel savings in the higher SOFC APU system efficiencies against the main engine bleed and extraction during cruise. The higher SOFC APU system efficiency compared to the

conventional APU on the ground can also provide considerable fuel saving and emissions reduction, particularly at the gate, but is limited by the fuel cell stack thermal fatigue characteristic.

Author

*Solid Oxide Fuel Cells; Feasibility Analysis; Auxiliary Power Sources; Fly By Wire Control; Aerospace Engineering*

**20070014752** NASA Glenn Research Center, Cleveland, OH, USA

**Noise Benefits of Rotor Trailing Edge Blowing for a Model Turbofan**

Woodward, Richard P.; Fite, E. Brian; Podboy, Gary G.; March 2007; 31 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA; Original contains color illustrations

Report No.(s): NASA/TM-2007-214666; E-15802; AIAA Paper 2007-1241; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014752>

An advanced model turbofan was tested in the NASA Glenn 9- by 15-Foot Low Speed Wind Tunnel (9x15 LSWT) to explore far field acoustic effects associated with rotor Trailing-Edge-Blowing (TEB) for a modern, 1,294 stage pressure ratio turbofan model. The TEB rotor (Fan9) was designed to be aerodynamically similar to the previously tested Fan1, and used the same stator and nacelle hardware. Fan9 was designed with trailing edge blowing slots using an external air supply directed through the rotor hub. The TEB flow was heated to approximate the average fan exit temperature at each fan test speed. Rotor root blockage inserts were used to block TEB to all but the outer 40 and 20% span in addition to full-span blowing. A configuration with full-span TEB on alternate rotor blades was also tested. Far field acoustic data were taken at takeoff/approach conditions at 0.10 tunnel Mach. Far-field acoustic results showed that full-span blowing near 2.0% of the total flow could reduce the overall sound power level by about 2 dB. This noise reduction was observed in both the rotor-stator interaction tones and for the spectral broadband noise levels. Blowing only the outer span region was not very effective for lowering noise, and actually increased the far field noise level in some instances. Full-span blowing of alternate blades at 1.0% of the overall flow rate (equivalent to full-span blowing of all blades at 2.0% flow) showed a more modest noise decrease relative to full-span blowing of all blades. Detailed hot film measurements of the TEB rotor wake at 2.0% flow showed that TEB was not every effective for filling in the wake defect at approach fan speed toward the tip region, but did result in overfilling the wake toward the hub. Downstream turbulence measurements supported this finding, and support the observed reduction in spectral broadband noise.

Author

*Trailing Edges; Engine Noise; Aircraft Engines; Aeroacoustics; Spanwise Blowing; Turbofan Engines; Low Speed Wind Tunnels*

## 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.

**20070014001** Old Dominion Univ., Norfolk, VA, USA

**Closed-Loop Performance Measures for Flight Controllers Subject to Neutron-Induced Upsets**

Gray, W. Steven; Zhang, Hong; Gonzalex, Oscar R.; Proceedings of the 42nd IEEE Conference on Decision and Control; Dec. 2003; Volume 3, pp. 2465-2470; In English; 42nd IEEE Conference on Decision and Control, December 2003, Maui, HI, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NCC1-392; NCC1-03026; NSF CCR-02-09094

Report No.(s): WeM14-3; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/CDC.2003.1272990>

It has been observed that atmospheric neutrons can produce single event upsets in digital flight control hardware. The phenomenon has been studied extensively at the chip level, and now system level experiments are underway. In this paper analytical closed-loop performance measures for the tracking error are developed for a plant that is stabilized by a recoverable computer system subject to neutron induced upsets. The underlying model is a Markov jump-linear system with process noise. The steady-state tracking error is expressed in terms of a generalized observability Gramian.

Author

*Flight Control; Digital Systems; Neutrons; Single Event Upsets; Feedback Control*

**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*.

**20070013828** Aerospace Corp., El Segundo, CA, USA

**Integrated Glass Ceramic Systems**

Helvajian, H.; Janson, S. W.; 19 Dec 03; 14 pp.; In English

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

Patent Info.: Filed Filed 19 Dec 03; US-Patent-Appl-SN-10-741 795

Report No.(s): PB2007-103101; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Integrated glass ceramic spacecraft include a plurality of glass ceramic components including molded, tempered, annealed, and patterned glass ceramic components coupled together for forming a support structure or frame or housing through which is communicated optical signals through an optical communications grid and electrical signals through an electrical communications grid, with the optical communications grid and electrical communication grid forming a composite electrooptical communications grid for spacecraft wide intercommunications. The support structure multifunctions as a frame, a housing, a support, a thermal control system, and as part of an electrooptical communications grid while encapsulating a plurality of optical, electronic, electrical, and MEMS devices between which is communicated the electrical and optical signals over the electrooptical communication grid.

NTIS

*Ceramics; Electro-Optics; Glass; Systems Integration; Telecommunication*

**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*.

**20070013790** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Initial Ares I Bending Filter Design**

Jang, Jiann-Woei; Bedrossian, Nazareth; Hall, Robert; Norris, H. Lee; Hall, Charles; Jackson, Mark; Feb. 8, 2007; 16 pp.; In English; 2007 AAS Guidance and Control Conference, 2-8 Feb. 2007, Breckenridge, CO, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

The Ares-I launch vehicle represents a challenging flex-body structural environment for control system design. Software filtering of the inertial sensor output will be required to ensure control system stability and adequate performance. This paper presents a design methodology employing numerical optimization to develop the Ares-I bending filters. The filter design methodology was based on a numerical constrained optimization approach to maximize stability margins while meeting performance requirements. The resulting bending filter designs achieved stability by adding lag to the first structural frequency and hence phase stabilizing the first Ares-I flex mode. To minimize rigid body performance impacts, a priority was placed via constraints in the optimization algorithm to minimize bandwidth decrease with the addition of the bending filters. The bending filters provided here have been demonstrated to provide a stable first stage control system in both the frequency domain and the MSFC MAVERIC time domain simulation.

Author

*Ares I Launch Vehicle; Bending; Control Systems Design; Flexible Bodies; Digital Filters; Structural Design*

**20070014484** NASA Glenn Research Center, Cleveland, OH, USA

**Dilution-of-Precision-Based Lunar Surface Navigation System Analysis Utilizing Earth-Based Assets**

Welch, Bryan W.; Connolly, Joseph W.; Sands, Obed S.; February 2007; 168 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 439432.07.04.03.01

Report No.(s): NASA/TP-2007-214407; E-15686; No Copyright; Avail.: CASI: [A08](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014484>



The NASA Vision for Space Exploration is focused on the return of astronauts to the Moon. Although navigation systems have already been proven in the Apollo missions to the Moon, the current exploration campaign will involve more extensive and extended missions requiring new concepts for lunar navigation. In contrast to Apollo missions, which were limited to the near-side equatorial region of the Moon, those under the Exploration Systems Initiative will require navigation on the Moon's limb and far side. These regions are known to have poor Earth visibility, but unknown is the extent to which a navigation system comprised solely of Earth-based tracking stations will provide adequate navigation solutions in these areas. This report presents a dilution-of-precision (DoP)-based analysis of the performance of a network of Earth-based assets. This analysis extends a previous analysis of a lunar network (LN) of navigation satellites by providing an assessment of the capability associated with a variety of assumptions. These assumptions pertain to the minimum provider elevation angle, nadir and zenith beam widths, and a total single failure in one of the Earth-based assets. The assessment is accomplished by making appropriately formed estimates of DoP. Different adaptations of DoP, such as geometrical DoP and positional DoP (GDoP and PDoP), are associated with a different set of assumptions regarding augmentations to the navigation receiver or transceiver.

Author

*Geometric Dilution of Precision; Lunar Surface; Systems Analysis; Navigation Satellites; Space Exploration*

## 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; 15 Launch Vehicles and Launch Operations; and 18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

**20070013891** NASA Johnson Space Center, Houston, TX, USA

#### **Space Shuttle MMOD Threat Mitigation Techniques**

Hyde, Justin L.; Christiansen, Eric L.; Kerr, James H.; [2007]; 1 pp.; In English; 2007 National Space and Missile Materials Symposium, 25-29 Jun. 2007, Keystone, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

Prior to each shuttle mission, threat assessments are performed to determine the risk of critical penetration, payload bay door radiator tube leak and crew module window replacement from Micrometeoroid and Orbital Debris (MMOD). Mission parameters, such as vehicle attitude, exposure time and altitude are used as inputs for the analysis. Ballistic limit equations, based on hypervelocity impact testing of shuttle materials are used to estimate the critical particle diameters of the outer surfaces of the vehicle. The assessments are performed using the BUMPER computer code at the NASA/JSC Hypervelocity Impact Technology Facility (HITF). The most critical involves the calculation of Loss of Crew and Vehicle (LOCV) risk. In recent years, NASA has implemented several techniques to reduce the risk to the Shuttle from MMOD impacts. This paper will describe on-orbit inspection of the reinforced carbon-carbon (RCC) regions and the methods used discern hypervelocity impact damage. Impact damage contingency plans and on-orbit repair techniques will also be discussed. The wing leading edge impact detection system (WLEIDS) and its role in the reduction of on-orbit risk reduction will be presented. Finally, an analysis of the effectivity of alternative shuttle flight attitudes on MMOD risk will be demonstrated.

Author

*Space Debris; Space Shuttle Missions; Micrometeoroids; Threat Evaluation; Hypervelocity Impact*

## 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*.

**20070013893** NASA Johnson Space Center, Houston, TX, USA

#### **Wireless Applications for Structural Monitoring of Inflatable Habitats**

Miller, Glenn J.; March 27, 2007; 40 pp.; In English; CANEUS/NASA Workshop: 'Fly-by-Wireless', 27-28 Mar. 2007, Grapevine, TX, USA; Original contains color illustrations

Contract(s)/Grant(s): 292487.08.05.06; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013893>

A viewgraph presentation on wireless applications for structural health monitoring of inflatable space structures is shown.

The topics include: 1) Background; 2) REquirements; 3) Implementation; and 4) structural health monitoring system summary. CASI

*Inflatable Space Structures; Wireless Communication; Technology Utilization; Systems Health Monitoring; Aerospace Vehicles*

## 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*.

**20070013895** NASA Langley Research Center, Hampton, VA, USA

#### **Aerothermodynamic Environments Definition for the Mars Science Laboratory Entry Capsule**

Edquist, Karl T.; Dyakonov, Artem A.; Wright, Michael J.; Tang, Chun Y.; 2007; 21 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit Meeting, 8-11 Jan. 2007, Reno, NV, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 857464.02.07.07

Report No.(s): AIAA 2007-1206; Copyright; Avail.: CASI: [A03](#), Hardcopy

An overview of the aerothermodynamic environments definition status is presented for the Mars Science Laboratory entry vehicle. The environments are based on Navier-Stokes flowfield simulations on a candidate aeroshell geometry and worst-case entry heating trajectories. Uncertainties for the flowfield predictions are based primarily on available ground data since Mars flight data are scarce. The forebody aerothermodynamics analysis focuses on boundary layer transition and turbulent heating augmentation. Turbulent transition is expected prior to peak heating, a first for Mars entry, resulting in augmented heat flux and shear stress at the same heatshield location. Afterbody computations are also shown with and without interference effects of reaction control system thruster plumes. Including uncertainties, analysis predicts that the heatshield may experience peaks of 225 W/sq cm for turbulent heat flux, 0.32 atm for stagnation pressure, and 400 Pa for turbulent shear stress. The afterbody heat flux without thruster plume interference is predicted to be 7 W/sq cm on the backshell and 10 W/sq cm on the parachute cover. If the reaction control jets are fired near peak dynamic pressure, the heat flux at localized areas could reach as high as 76 W/sq cm on the backshell and 38 W/sq cm on the parachute cover, including uncertainties. The final flight environments used for hardware design will be updated for any changes in the aeroshell configuration, heating design trajectories, or uncertainties.

Author

*Aerothermodynamics; Atmospheric Entry; Aeroshells; Boundary Layer Transition; Forebodies; Shear Stress; Turbulent Heat Transfer; Plumes*

**20070014070** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Spacecraft Charging in Low Temperature Environments**

Parker, Linda N.; Jan. 11, 2007; 37 pp.; In English; 45th AIAA Aerospace Science Meeting, 8-11 Jan. 2007, Reno, NV, USA; Copyright; Avail.: CASI: [A03](#), Hardcopy

Spacecraft charging in plasma and radiation environments is a temperature dependent phenomenon due to the reduction of electrical conductivity in dielectric materials at low temperatures. Charging time constants are proportional to  $1/\text{conductivity}$  may become very large (on the order of days to years) at low temperatures and accumulation of charge densities in insulators in charging environments traditionally considered benign at ambient temperatures may be sufficient to produce charge densities and electric fields of concern in insulators at low temperatures. Low temperature charging is of interest because a number of spacecraft-primarily infrared astronomy and microwave cosmology observatories-are currently being design, built, and or operated at very cold temperatures on the order of 40K to 100K. This paper reviews the temperature dependence of spacecraft charging processes and material parameters important to charging as a function of temperature with an emphasis on low temperatures regimes.

Author

*Low Temperature Environments; Plasma Radiation; Spacecraft Charging; Temperature Dependence; Aerospace Systems*



## 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*.

**20070013773** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Electric Propulsion Interactions Code (EPIC): Recent Enhancements and Goals for Future Capabilities**

Gardner, Barbara M.; Kuharski, Robert A.; Davis, Victoria A.; Ferguson, Dale C.; [2007]; 7 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The Electric Propulsion Interactions Code (EPIC) is the leading interactive computer tool for assessing the effects of electric thruster plumes on spacecraft subsystems. EPIC, developed by SAIC under the sponsorship of the Space Environments and Effects (SEE) Program at the NASA Marshall Space Flight Center, has three primary modules. One is PlumeTool, which calculates plumes of electrostatic thrusters and Hall-effect thrusters by modeling the primary ion beam as well as elastic scattering and charge-exchange of beam ions with thruster-generated neutrals. ObjectToolkit is a 3-D object definition and spacecraft surface modeling tool developed for use with several SEE Program codes. The main EPIC interface integrates the thruster plume into the 3-D geometry of the spacecraft and calculates interactions and effects of the plume with the spacecraft. Effects modeled include erosion of surfaces due to sputtering, re-deposition of sputtered materials, surface heating, torque on the spacecraft, and changes in surface properties due to erosion and deposition. In support of Prometheus I (JIMO), a number of new capabilities and enhancements were made to existing EPIC models. Enhancements to EPIC include adding the ability to scale and view individual plume components, to import a neutral plume associated with a thruster (to model a grid erosion plume, for example), and to calculate the plume from new initial beam conditions. Unfortunately, changes in program direction have left a number of desired enhancements undone. Variable gridding over a surface and resputtering of deposited materials, including multiple bounces and sticking coefficients, would significantly enhance the erosion/deposition model. Other modifications such as improving the heating model and the PlumeTool neutral plume model, enabling time dependent surface interactions, and including EMI and optical effects would enable EPIC to better serve the aerospace engineer and electric propulsion systems integrator. We review EPIC S overall capabilities and recent modifications, and discuss directions for future enhancements.

Author

*Electric Propulsion; Spacecraft Propulsion; Computer Programs; Spacecraft Environments*

**20070013898** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Electrodynamic Bare Tether Systems as a Thruster for the Momentum-Exchange/Electrodynamic Reboost(MXER-Project)**

Khazanov, G. V.; Krivorutsky, E. N.; Gallagher, D. L.; Journal of Geophysical Research; April 27, 2006; ISSN 0148-0227; Volume 111; 7 pp.; In English; Original contains color illustrations  
Contract(s)/Grant(s): M-ISP-04-37; Copyright; Avail.: Other Sources  
ONLINE: <http://dx.doi.org/10.1029/2005JA011205>

The concept of electrodynamic tether propulsion has a number of attractive features and has been widely discussed for different applications. Different system designs have been proposed and compared during the last 10 years. In spite of this, the choice of proper design for any particular mission is a unique problem. Such characteristics of tether performance as system acceleration, efficiency, etc., should be calculated and compared on the basis of the known capability of a tether to collect electrical current. We discuss the choice of parameters for circular and tape tethers with regard to the Momentum-Exchange/Electrodynamic Reboost (MXER) tether project.

Author

*System Effectiveness; Electromagnetic Propulsion; Tethering; Selection*

**20070014064** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Nuclear Thermal Propulsion (NTP) Development Activities at the NASA Marshall Space Flight Center - 2006 Accomplishments**

Ballard, Richard O.; 2007; 51 pp.; In English; Space Technology and Applications International Forum (STAIF) 2007 Conference, 12-15, Feb. 2007, Albuquerque, NM, USA; No Copyright; Avail.: CASI: [A04](#), Hardcopy  
ONLINE: <http://hdl.handle.net/2060/20070014064>

In 2005-06, the Prometheus program funded a number of tasks at the NASA-Marshall Space Flight Center (MSFC) to support development of a Nuclear Thermal Propulsion (NTP) system for future manned exploration missions. These tasks include the following: 1. NTP Design Develop Test & Evaluate (DDT&E) Planning 2. NTP Mission & Systems Analysis / Stage Concepts & Engine Requirements 3. NTP Engine System Trade Space Analysis and Studies 4. NTP Engine Ground Test Facility Assessment 5. Non-Nuclear Environmental Simulator (NTREES) 6. Non-Nuclear Materials Fabrication & Evaluation 7. Multi-Physics TCA Modeling. This presentation is a overview of these tasks and their accomplishments

Author

*NASA Programs; Nuclear Propulsion; Spacecraft Propulsion; Dynamic Models; Mathematical Models*

**20070014067** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Cryogenic Propellant Depot Experiments, Demonstrations and Applications**

Howell, Joe T.; Fikes, John C.; Henley, Mark; February 15, 2007; 15 pp.; In English; Space Technology and Applications International Forum (STAIF) 2007, 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

This viewgraph presentation reviews the concept of a space-based Cryogenic Propellant Depot, the goal of which is to enable automated zero-g storage and transfer of cryogenic fluids from supply tanks to user tanks: safely, reliably, and with minimum loss of propellant. This is viewed as an enabling technology for the further exploration of the solar system, both robotic and manned. Possible designs of potential depots are shown and the technological challenges are reviewed.

CASI

*Cryogenic Fluids; Cryogenic Fluid Storage; Propellant Storage; Storage Tanks*

## 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 25 through 29*. For astrochemistry see category *90 Astrophysics*.

**20070013804**

#### **Palladium-Based Electrocatalysts and Fuel cells employing such Electrocatalysts**

Masel, R. I.; Zhu, Y.; Larsen, R. T.; 2 Apr 04; 12 pp.; In English

Contract(s)/Grant(s): DEGF-02-9ER-14993

Patent Info.: Filed 2 Apr 04; US-Patent-Appl-SN-10-817 361

Report No.(s): PB2007-103121; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A direct organic fuel cell includes a fluid fuel comprising formic acid, an anode having an electrocatalyst comprising palladium nanoparticles, a fluid oxidant, a cathode electrically connected to the anode, and an electrolyte interposed between the anode and the cathode.

NTIS

*Electrocatalysts; Fuel Cells; Palladium; Nanoparticles*

**20070013870** The Geneva Foundation, Tacoma, WA, USA

#### **Skin Interface Pressure Associated with the NATO Litter**

Mazer, S.; Jun. 2001; 56 pp.; In English

Contract(s)/Grant(s): N99-003; MDA 905-99-1-0010

Report No.(s): PB2007-107657; Copyright; Avail.: National Technical Information Service (NTIS)

The NATO litter, a canvas stretcher, is the primary transport device and hospital bed in military and contingency operations. The purpose of this study was to measure peak skin interface pressures and the total area of the body exposed to skin interface pressure above 30 mm Hg at different areas of the body on different configurations of the NATO litter. These results are important in characterizing one risk factor for pressure ulcer formation. Subjects, who served as their own controls, were studied in three positions (supine, supine with a 40-degree backrest elevation, and 30-degree lateral rotation with a 0-degree backrest elevation). A repeated measures design was used to determine the peak pressures and skin surface area exposed to greater than 30 mm Hg for each body region (e.g., occiput, scapula, sacrum, trochanter, calf, and heel) on 4 different surfaces (NATO litter, NATO litter with wool blanket, NATO litter with aerovac (AE) mattress, and Maxifloat mattress). Data were analyzed using repeated-measures ANOVA. Results: 32 men and women were selected based on a

stratification scheme (gender and BMI characterization). Peak pressures for all body areas on all litter surfaces were greater than 30 mm Hg, indicating an increased risk for pressure ulcer formation. There was no significant reduction in pressure or surface area with the addition of the wool military blanket. Adding the AE mattress significantly decreased pressures on all body positions, although pressure reduction was not comparable to the replacement mattress. Placement in the 30-degree side-lying position decreased pressure on the buttocks and head, but significantly increased pressure on the heels, hip, shoulder, and arms. Heel pressure was not relieved in any position on any litter surface. Placement in the 40-degree backrest position significantly increased pressures on the buttocks and heels for all surfaces.

NTIS

*North Atlantic Treaty Organization (NATO); Stretchers; Skin (Anatomy); Pressure*

**20070013879** Burns Doane Swecker and Mathis, LLP, Alexandria, VA, USA, North Carolina Univ., Chapel Hill, NC, USA  
**Method and Apparatus for Attaching Nanostructure-Containing Material onto a Sharp Tip of an Object and Related Articles**

Zhou, O. Z.; Gaol, B.; Yue, G.; Oh, S.; 10 May 04; 19 pp.; In English

Contract(s)/Grant(s): ONR-N00014-98-1-05907

Patent Info.: Filed Filed 10 May 04; US-Patent-Appl-SN-10-842 357

Report No.(s): PB2007-102979; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A method for attaching nanostructure-containing material onto a sharp tip of an object includes forming a suspension of pre-formed nanostructure-containing material in a liquid medium. An electrode is immersed in the suspension. The sharp tip of the object is arranged to be in contact with the suspension. A voltage is applied to the immersed electrode and to the sharp tip. The nanostructure-containing material attaches to the sharp tip of the object.

NTIS

*Deposition; Nanostructure (Characteristics); Electrophoresis*

**20070013880** Texas Univ., El Paso, TX, USA

**Tack Coat Field Acceptance Criterion, Project Summary Report**

Eedula, S. R.; Tandon, V.; Sep. 2006; 4 pp.; In English

Report No.(s): PB2007-107257; PSR-0-5216-S; No Copyright; Avail.: CASI: [A01](#), Hardcopy

To evaluate quality of tack coat in the field, a UTEP Pull-Off Device (UPOD) was developed under project 0-4129 titled Development of an Objective Field Test to Determine Tack Coat Adequacy. However, a field acceptance criterion was not developed. In addition, the prototype UPOD device was fabricated using off-the-shelf components; the device needed to be modified to make sure that the produced devices are reproducible. Thus, the objectives of this research were to develop a reproducible UPOD device and develop a field acceptance criterion.

NTIS

*Criteria; Pavements; Fabrication; Mechanical Devices; Coatings*

**20070013931** Bechtel Jacobs Co., LLC., Oak Ridge, TN, USA, Argonne National Lab., IL USA, Illinois Inst. of Tech., Chicago, IL, USA, Illinois Univ., Chicago, IL, USA

**Study on Degradation of a Commercial Rigid Polyurethane Foam Used for Filling of Process Gas Equipment (PGE) and Pipes and Corrosion Behavior of Pipes at K-25/K-27**

Singh, D. N.; Lorenzo-Martin, L.; Routbort, J. L.; Pagilla, K.; Urgan-Demirtas, M.; Aug. 2006; 163 pp.; In English

Report No.(s): DE2006-895663; ANL-06/32; No Copyright; Avail.: National Technical Information Service (NTIS)

This study has been undertaken to investigate the degradation behavior of a commercial urethane foam. Bechtel Jacobs Company (BJC) plans to use urethane for infiltrating segmented process gas equipment (PGE) at the K-25/K-27 plants to restrict the mobility of the various radionuclides. Subsequently, the infiltrated PGE will be sent to the Environmental Management Waste Management Facility (EMWMF) at the Oak Ridge Reservation (ORR) for disposal. The objective of this study was to generate test data to be used in evaluating the longterm performance of the urethane foam in the landfill environment. The longevity of the foam was evaluated under plausible degradation scenarios that may lead to foam failure, which could then compromise the integrity of the final cap during the life of the landfill. The degradation effects of various conditions such as mechanical stresses, heat, moisture, temperature cycling, biodegradation, and radiation exposure were studied.

NTIS

*Corrosion; Degradation; Foams; Gas Pipes; Pipes (Tubes); Polyurethane Foam; Urethanes*

**20070014592** Lawrence Livermore National Lab., Livermore, CA USA

**Use of Lubricants in the NIF**

Gourdin, W.; Biltoft, P.; Jul. 06, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896602; UCRL-TR-222672; No Copyright; Avail.: National Technical Information Service (NTIS)

There are two principal concerns that govern the use of lubricants in National Ignition Facility (NIF): (1) Airborne molecular contaminants (AMCs)--AMCs are known to seriously degrade the performance of sol-gel coated optics. AMCs are produced by the slow outgassing of residues (non-volatile residues or 'NVRs') of high molecular weight compounds left on surfaces. Lubricants, particularly hydrocarbon lubricants, are a primary source of such NVRs. (2) Particulates--Particulates that accumulate on optical surfaces can cause permanent physical damage when exposed to high energy density laser light. Lubricant residues exposed to high energy density light will pyrolyze or decompose and produce carbon particulates. The NIF Approved Materials Database lists several lubricants that have been tested for use in NIF environments. Many of these lubricants were tested according to MELs 99-006 (oven outgassing test) or 99-007 (vacuum outgassing test). In these tests, the change in percent transmission of light through a sol-gel coated optic placed next to the sample under evaluation is used as the diagnostic. Samples that cause less than 0.1% change in optical transmission are deemed suitable for use inside beam enclosures.

NTIS

*Lubricants; Laboratories; Research Facilities; Contaminants*

**20070014593** Lawrence Livermore National Lab., Livermore, CA USA

**Thermal Imaging Investigation of Modified Fused Silica at Surface Damage Sites for Understanding the Underlying Mechanisms of Damage Growth**

Negres, R. A.; Burke, M. W.; DeMange, P.; Sutton, S. B.; Feit, M. D.; Nov. 03, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896608; UCRL-PROC-225830; No Copyright; Avail.: Department of Energy Information Bridge

We use an infrared thermal imaging system in combination with a fluorescence microscope to map the dynamics of the local surface temperature and fluorescence intensity under cw, UV excitation of laser-modified fused silica within a damage site. Based on a thermal diffusion model, we estimate the energy deposited via linear absorption mechanisms and derive the linear absorption coefficient of the modified material. The results indicate that the damage growth mechanism is not entirely based on linear absorption. Specifically, the absorption cross-section derived above would prove insufficient to cause a significant increase in the temperature of the modified material under nanosecond, pulsed excitation (via linear absorption at ICF laser fluences).

NTIS

*Damage; Silica Glass; Thermal Diffusion; Thermal Mapping; Imaging Techniques*

**20070014707** Lockheed Martin Corp., Schenectady, NY, USA

**Approximate Solutions for a Self-Folding Problem of Carbon Nanotubes**

Mikata, Y.; Aug. 22, 2006; 27 pp.; In English

Report No.(s): DE2006-896369; LM-06K090; No Copyright; Avail.: Department of Energy Information Bridge

This paper treats approximate solutions for a self-folding problem of carbon nanotubes. It has been observed in the molecular dynamics calculations (1) that a carbon nanotube with a large aspect ratio can self-fold due to van der Waals force between the parts of the same carbon nanotube. The main issue in the self-folding problem is to determine the minimum threshold length of the carbon nanotube at which it becomes possible for the carbon nanotube to self-fold due to the van der Waals force. An approximate mathematical model based on the force method is constructed for the self-folding problem of carbon nanotubes, and it is solved exactly as an elastica problem using elliptic functions. Additionally, three other mathematical models are constructed based on the energy method. As a particular example, the lower and upper estimates for the critical threshold (minimum) length are determined based on both methods for the (5,5) armchair carbon nanotube.

NTIS

*Approximation; Carbon Nanotubes; Folding*

**20070014708** Lockheed Martin Corp., Schenectady, NY, USA

**Reduction of Thermal Conductivity in Wafer-Bonded Silicon**

Liau, Z. L.; Danielson, L. R.; Fourspring, P. M.; Hu, L.; Chen, G.; Nov. 27, 2006; 14 pp.; In English

Report No.(s): DE2006-896374; LM-06K135; No Copyright; Avail.: National Technical Information Service (NTIS)

Blocks of silicon up to 3-mm thick have been formed by directly bonding stacks of thin wafer chips. These stacks showed significant reductions in the thermal conductivity in the bonding direction. In each sample, the wafer chips were obtained by polishing a commercial wafer to as thin as 36 (micro)m, followed by dicing. Stacks whose starting wafers were patterned with shallow dots showed greater reductions in thermal conductivity. Diluted-HF treatment of wafer chips prior to bonding led to the largest reduction of the effective thermal conductivity, by approximately a factor of 50. Theoretical modeling based on restricted conduction through the contacting dots and some conduction across the planar nanometer air gaps yielded fair agreement for samples fabricated without the HF treatment.

NTIS

*Silicon; Thermal Conductivity; Wafers*

**20070014709** Pacific Northwest National Lab., Richland, WA, USA, Arizona State Univ., Tempe, AZ USA

**Portable Analyzer Based on Microfluidics/Nanoengineered Electrochemical Sensors for In-situ Characterization of Mixed Wastes**

Lin, Y.; Fryxell, G. E.; Yantasee, W.; Liu, G.; Wang, Z.; Jun. 01, 2006; 8 pp.; In English

Report No.(s): DE2006-896377; ERSD-90138LIN-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

Required characterizations of the DOE's transuranic (TRU) and mixed wastes (MW) before disposing and treatment of the wastes are currently costly and have lengthy turnaround. Research toward developing faster and more sensitive characterization and analysis tools to reduce costs and accelerate throughputs is therefore desirable. This project is aimed at the development of electrochemical sensors, specific to toxic transition metals, uranium, and technetium, that can be integrated into the portable sensor systems. This system development will include fabrication and performance evaluation of electrodes as well as understanding of electrochemically active sites on the electrodes specifically designed for toxic metals, uranium and technetium detection. Subsequently, these advanced measurement units will be incorporated into a microfluidic prototype specifically designed and fabricated for field-deployable characterizations of such species.

NTIS

*Characterization; Microfluidic Devices; Analyzers; Portable Equipment; Electrochemistry; Sensors*

**20070014745** Michigan Univ., Ann Arbor, MI, USA

**Development of Sulfur and Carbon Tolerant Reforming Alloy Catalysts Aided by Fundamental Atomistics Insights. Topical Technical Report**

Linic, S.; Aug. 31, 2006; 26 pp.; In English

Contract(s)/Grant(s): FC26-05NT42516

Report No.(s): DE2006-895630; No Copyright; Avail.: National Technical Information Service (NTIS)

Current hydrocarbon reforming catalysts suffer from rapid carbon and sulfur poisoning. Even though there is a tremendous incentive to develop more efficient catalysts, these materials are currently formulated using inefficient trial and error experimental approaches. We have utilized a novel hybrid experimental/theoretical approach, combining quantum Density Functional Theory (DFT) calculations and various state-of-the-art experimental tools, to formulate carbon tolerant reforming catalysts. We have employed DFT calculations to develop molecular insights into the elementary chemical transformations that lead to carbon poisoning of Ni catalysts. Based on the obtained molecular insights, we have identified, using DFT quantum calculation, Sn/Ni alloy as a potential carbon tolerant reforming catalyst. Sn/Ni alloy was synthesized and tested in steam reforming of methane, propane, and isooctane. We demonstrated that the alloy catalyst is carbon-tolerant under nearly stoichiometric steam-to-carbon ratios. Under these conditions, monometallic Ni is rapidly poisoned by sp<sup>2</sup> carbon deposits. The research approach is distinguished by a few characteristics: (a) Knowledge-based, bottom-up approach, compared to the traditional trial and error approach, allows for a more efficient and systematic discovery of improved catalysts. (b) The focus is on exploring alloy materials which have been largely unexplored as potential reforming catalysts.

NTIS

*Carbon; Catalysts; Sulfur; Alloys*

**20070014767** Lawrence Livermore National Lab., Livermore, CA USA

**Development of a Low Loss High Dielectric Strength Microwave Substrate**

Sanders, D.; Sampayan, S.; Caporaso, G.; Rhodes, M.; Watson, J.; Jun. 14, 2006; 6 pp.; In English

Report No.(s): DE2006-896286; UCRL-PROC-222059; No Copyright; Avail.: National Technical Information Service (NTIS)



This work describes a comparison of two candidate materials for pulse forming line fabrication with respect to bulk dielectric breakdown, frequency response of relative permittivity and dielectric loss. One material is a commercially available microwave substrate material that can be procured in sheet form without a high voltage specification while the other is a newly developed material that also comes in sheet form that can also be cast between the electrodes.

NTIS

*Dielectric Properties; High Strength; Microwaves; Substrates*

**20070014776** Illinois Univ. at Urbana-Champaign, Urbana, IL, USA

**Tank Car Reliability Design and Analysis**

Pecknold, D.; Sehitoglu, H.; Barkan, C. P. L.; Kibey, S.; Lee, O. C.; Mar. 2007; 99 pp.; In English  
Report No.(s): PB2007-107177; No Copyright; Avail.: National Technical Information Service (NTIS)

This report presents the results of the Federal Railroad Administration project DTFR DV-00-G-60019 (Tank Car Reliability Design and Analysis), carried out in the Department of Civil and Environmental Engineering and the Department of Mechanical and Industrial Engineering at the University of Illinois at Urbana-Champaign. The overall objective of the project was to propose and develop new and improved rational procedures for assessing the structural integrity of stub sill tank cars, in order to provide higher levels of assurance against the occurrence of structural failure of a car that could lead to an accident. This research specifically focuses on procedures for establishing safe inspection intervals to detect the presence of fatigue cracks in the stub sill assembly before they grow to critical size.

NTIS

*Design Analysis; Rail Transportation; Reliability Analysis; Transportation*

**20070014789** Minnesota Univ., Minneapolis, MN, USA

**New Concept for the Fabrication of Hydrogen Selective Silica Membranes. Annual Report. Reporting period 08/01/2005 through 07/31/2006**

Tsapatsis, M.; Nov. 01, 2006; 19 pp.; In English

Contract(s)/Grant(s): DE-FG26-04NT42119

Report No.(s): DE2006-896300; No Copyright; Avail.: National Technical Information Service (NTIS)

We are attempting to fabricate H<sub>2</sub>-selective silica-based films by layer-by-layer deposition as a new approach for thin films. A sonication-assisted deposition method was mainly used for layer-by-layer deposition. In addition, other approaches such as a dip-coating and the use of a polymer matrix with a layered silicate were contrived as well. This report shows the progress done during the 2nd Year of this award.

NTIS

*Fabrication; Hydrogen; Membranes; Silicon Dioxide*

## 24

### COMPOSITE MATERIALS

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

**20070013794** NASA Glenn Research Center, Cleveland, OH, USA

**Composite Nanomechanics: A Mechanistic Properties Prediction**

Chamis, Christos C.; Handler, Louis M.; Manderscheid, Jane M.; February 2007; 30 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 984754.02.07.03

Report No.(s): NASA/TM-2007-214673; E-15643; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013794>

A unique mechanistic theory is described to predict the properties of nanocomposites. The theory is based on composite micromechanics with progressive substructuring down to a nanoscale slice of a nanofiber where all the governing equations are formulated. These equations have been programmed in a computer code. That computer code is used to predict 25 properties of a mononanofiber laminate. The results are presented graphically and discussed with respect to their practical significance. Most of the results show smooth distributions. Results for matrix-dependent properties show bimodal through-the-thickness distribution with discontinuous changes from mode to mode.

Author

*Nanocomposites; Nanotechnology; Mechanical Properties; Fibers; Nanofabrication*

**20070014085** NASA White Sands Test Facility, NM, USA

**Application of Raman Spectroscopy for Nondestructive Evaluation of Composite Materials**

Washer, Glenn A.; Brooks, Thomas M. B.; Saulsberry, Regor; June 29, 2007; 6 pp.; In English; 3rd International Conference of Electromagnetic Near-Field Characterization and Imaging (ICONIC 2007), 27029 Jun. 2007, Saint Louis, MO, USA; Copyright; Avail.: CASI: [A02](#), Hardcopy

This paper will present an overview of efforts to investigate the application of Raman spectroscopy for the characterization of Kevlar materials. Raman spectroscopy is a laser technique that is sensitive to molecular interactions in materials such as Kevlar, graphite and carbon used in composite materials. The overall goal of this research reported here is to evaluate Raman spectroscopy as a potential nondestructive evaluation (NDE) tool for the detection of stress rupture in Kevlar composite over-wrapped pressure vessels (COPVs). Characterization of the Raman spectra of Kevlar yarn and strands will be presented and compared with analytical models provided in the literature. Results of testing to investigate the effects of creep and high-temperature aging on the Raman spectra will be presented.

Author

*Composite Materials; Nondestructive Tests; Raman Spectroscopy; Raman Spectra; Aging (Materials)*

**20070014717** Lane (Philip Douglas), Potomac Falls, VA, USA

**Intermittently Connected Metal Matrix Composite Bars**

Joseph, B. E.; Nolte, R.; Rowe, M. M.; Witzgall, J. F.; Wolfe, G. W.; 24 Nov 04; 12 pp.; In English

Contract(s)/Grant(s): DAAD19-01-2-0006

Patent Info.: Filed Filed 24 Nov 04; US-Patent-Appl-SN-10-995-517

Report No.(s): PB2007-105986; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention provides for assemblies comprising metal matrix composite bars where the bars only intermittently have mutual contact. Minimally two bars of metal matrix composite are joined, for example, by lap joints, or by the use of incorporated tabs and slots or over-lapping slots, at areas of mutual contact to form the assemblies. The metal matrix composite assemblies of the present invention may be readily assembled to provide structures, supports, or sub-assemblies, and the like, that may exhibit high strength and stiffness coupled with relatively low mass. Additionally, such assemblies may withstand exposure to elevated temperatures higher than can be tolerated by polymeric composites. Such assemblies are expected to be particularly suitable for lightweight, stiff support structures for space booms, satellite structures, mirror backings, solar panel supports, wall reinforcement, and the like.

NTIS

*Metal Matrix Composites; Assembling; Bars*

**20070014754** NASA Glenn Research Center, Cleveland, OH, USA

**Progressive Fracture of [0/90/ + or - Theta]s Composite Structure Under Uniform Pressure Load**

Gotsis, Pascalis K.; Chamis, Christos C.; Gotsis, Christos K.; Mouratidis, Ericos; [2007]; 6 pp.; In English; ATEMA 2007 International Conference, 6-10 Aug. 2007, Montreal, Canada; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 561581.02.08.03.15.03; Copyright; Avail.: CASI: [A02](#), Hardcopy

S-Glass/epoxy [0/90/plus or minus theta]s for theta =45 deg., 60 deg., and 75 deg. laminated fiber-reinforced composite stiffened plate was simulated to investigated for damage and fracture progression under uniform pressure. An integrated computer code was augmented for the simulation of the damage initiation, growth, accumulation, and propagation to fracture and to structural collapse. Results show in detail the damage progression sequence and structural fracture resistance during different degradation stages. Damage through the thickness of the laminate initiated first at [0/90/plus or minus 45]s at 15.168 MPa (2200 psi), followed by [0/90/plus or minus 60]s at 16.96 MPa (2460 psi) and finally by [0/90/plus or minus 75]s at 19.3 MPa (2800 psi). After damage initiation happened the cracks propagate rapidly to structural fracture.

Author

*Composite Structures; Pressure Distribution; Fracture Mechanics; S Glass; Loads (Forces)*



**INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY**

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

**20070013835** Westinghouse Savannah River Co., Aiken, SC, USA

**Corrosion of Lead Shielding in Model 9975 Package**

Subramanian, K. H.; Mar. 2006; 41 pp.; In English

Report No.(s): DE2006-895488; WSRC-TR-200-00094; No Copyright; Avail.: National Technical Information Service (NTIS)

Experiments were performed to determine the corrosion rate of lead when exposed to off-gas or degradation products of organic materials used in the model 9975 package.(1) The experiments were completed within the framework of a parametric test matrix with variables of organic configuration, temperature, humidity and the effect of durations of exposure on the corrosion of lead in the 9975 package. The room temperature vulcanizing (RTV) sealant was the most corrosive organic species in the testing, followed by the polyvinyl acetate (PVAc) glue. The Celotex(copyright) material uniquely induced measurable corrosion only in situations with condensed water, and to a much lesser extent than the PVAc glue and RTV. The coupons exhibited faster corrosion at higher temperatures than at room temperatures. There was a particularly pronounced effect of condensed water as the coupons exposed in the cells with condensed water exhibited much higher corrosion rates. In the 9975 package, the PVAc glue was determined to be the most aggressive due to its proximity in the design. The condition considered most representative of the package conditions is that of the coupon exposed to the Celotex(copyright)/glue organic exposed in the ambient humidity conditions. The corrosion rate of 2 mpy measured in the laboratory experiments for this condition is considered to be a bounding condition to the 9975 package conditions when the laboratory results are extrapolated to actual package conditions, and is recommended as a conservative estimate for package performance calculations.

NTIS

*Corrosion; Shielding*

**20070013854** Brookhaven National Lab., Upton, NY USA

**Molecular Mechanism of Uranium Reduction by Clostridia and Its Manipulation Annual Report**

Francis, A. J.; Gao, W.; Chidambaram, D.; Dodge, C. J.; Nov. 01, 2006; 7 pp.; In English

Report No.(s): DE2006-896458; BNL-77302-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

This research addresses the need for detailed studies of the enzymatic mechanisms for reduction of radionuclides and/or metals by fermentative microorganisms. The overall objective of this research is to elucidate systematically the molecular mechanisms involved in the reduction of uranium by Clostridia. We propose to (1) determine the role of hydrogenases in uranium reduction, (2) purify the enzymes involved in uranium reduction, (3) determine the mechanisms of reduction, e.g., one or two electron transfer reactions, and (4) elucidate the genetic control of the enzymes and cellular factors involved in uranium reduction. This is a collaborative study between BNL and Stanford University involving expertise in biomolecular science, biochemistry, microbiology, and electrochemistry.

NTIS

*Microorganisms; Molecular Biology; Radioactive Isotopes; Uranium; Biochemistry*

**20070013857** Hoffmann and Baron, LLP, Syosset, NY, USA, Rutgers - The State Univ., New Brunswick, NJ, USA, Maryland Univ., College Park, MD, USA, Medicine and Dentistry Univ. of New Jersey, Jersey City, NJ, USA

**Multifunctional Biosensor Based on ZnO Nanostructures**

Lu, Y.; Zhang, Z.; Emanetoglu, N. W.; Inouye, M.; Mirochnitchenko, O.; 6 Jun 03; 15 pp.; In English

Contract(s)/Grant(s): NSF-ECS-008854999; NSF-CCR-0103096

Patent Info.: Filed 6 Jun 03; US-Patent-Appl-SN-10-456 050

Report No.(s): PB2007-102436; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention provides the multifunctional biological and biochemical sensor technology based on ZnO nanostructures. The ZnO nanotips serve as strong DNA or protein molecule binding sites to enhance the immobilization. Patterned ZnO nanotips are used to provide conductivity-based biosensors. Patterned ZnO nanotips are also used as the gate for field-effect transistor (FET) type sensors. Patterned ZnO nanotips are integrated with SAW or BAW based biosensors. These ZnO nanotip based devices operate in multimodal operation combining electrical, acoustic and optical sensing

mechanisms. The multifunctional biosensors can be arrayed and combined into one biochip, which will enhance the sensitivity and accuracy of biological and biochemical detection due to strong immobilization and multimodal operation capability. Such biological and biochemical sensor technology are useful in detection of RNA-DNA, DNA-DNA, protein-protein, protein-DNA and protein-small molecules interaction. It can be further applied for drug discovery, and for environmental monitoring and protection.

NTIS

*Bioinstrumentation; Nanostructures (Devices); Zinc Oxides; Detection*

**20070013868** Pacific Northwest National Lab., Richland, WA, USA, Princeton Univ., NJ, USA

**Aluminum-Containing Phases in Tank Waste: Precipitation and Deposition of Aluminum-Containing Phases**

Mattigod, S.; Wellman, D. M.; Aksay, I.; Dabbs, D. M.; January 2005; 6 pp.; In English

Report No.(s): DE2006-896465; PROJ-ID-NO-95016; No Copyright; Avail.: National Technical Information Service (NTIS)

Aluminosilicate deposit buildup experienced during the tank waste volume-reduction process at the Savannah River Site (SRS) required an evaporator to be shut down in October 1999. Recent investigations illustrated the accumulation 7 wt% uranium, 3% was <sup>235</sup>U and absent of neutron poisons, within these deposits and presented a criticality concern. The Waste Processing Technology Section of Westinghouse Savannah River Company at SRS is now collaborating with a team from Pacific Northwest National Laboratory in efforts to identify the phases controlling uranium solubility and understand the conditions under which they precipitate.

NTIS

*Aluminum; Deposition; Radioactive Wastes; Waste Management; Precipitation (Chemistry)*

**20070013914** Battelle Columbus Labs., OH USA

**Arsenic Removal from Drinking Water by Process Modifications to Coagulation/Filtration U.S. EPA Demonstration Project at Lidgerwood, ND, Final Evaluation Report**

Condit, W. E.; Chen, A. S. C.; Wang, L.; Dec. 2006; 78 pp.; In English

Contract(s)/Grant(s): 68-C-00-185

Report No.(s): PB2007-107186; No Copyright; Avail.: National Technical Information Service (NTIS)

This report documents the activities performed and the results obtained for the arsenic removal treatment technology demonstration project at the Lidgerwood, North Dakota, site. The objectives of the project were to evaluate: (1) the effectiveness of process modifications to an existing coagulation/gravity filtration plant in removing arsenic to meet the new arsenic maximum contaminant level (MCL) of 10 microg/L, (2) the reliability of the treatment system, (3) the required system operation and maintenance (O&M) and operator skills, and (4) the capital and O&M cost of the technology. The project also characterized water in the distribution system and process residuals produced by the treatment system.

NTIS

*Arsenic; Coagulation; Filtration; Potable Water*

**20070013915** Battelle Columbus Labs., OH USA

**Arsenic Removal from Drinking Water by Adsorptive Media U.S. EPA Demonstration Project at Dummerston, VT, Six-Month Evaluation Report**

Lipps, J. P.; Chen, A. S. C.; Jan. 2007; 62 pp.; In English

Contract(s)/Grant(s): 68-C-00-185

Report No.(s): PB2007-107187; No Copyright; Avail.: National Technical Information Service (NTIS)

This report documents the activities performed during and the results obtained from the first six months (from June 22, 2005 through December 22, 2005) of the arsenic removal treatment technology demonstration project at Charette Mobile Home Park (CMHP) in Dummerston, Vermont. The objectives of the project are to evaluate (1) the effectiveness of an Aquatic Treatment Systems (ATS) arsenic removal system in removing arsenic to meet the new arsenic maximum contaminant level (MCL) of 10 microg/L, (2) the reliability of the treatment system, (3) the required system operation and maintenance (O&M) and operators skills, and (4) the capital and O&M cost of the technology. The project also characterizes water in the distribution system and residuals produced by the treatment process.

NTIS

*Adsorptivity; Arsenic; Potable Water*

**20070013919** Stanford Linear Accelerator Center, CA, USA, National Museum of Natural History, Paris, France, Agricultural Univ., Wageningen, Netherlands

**Selenium Speciation in Biofilm from Granular Sludge Bed Reactors Used for Wastewater Treatment**

Hullenbusch, E. V.; Farges, F.; Lenz, M.; Lens, P.; Brown, G. E.; Nov. 01, 2006; 3 pp.; In English

Report No.(s): DE2006-896409; SLAC-PUB-12225; No Copyright; Avail.: Department of Energy Information Bridge

Se K-edge XAFS spectra were collected for various model compounds of Se as well as for 3 biofilm samples from bioreactors used for Se-contaminated wastewater treatment. In the biofilm samples, Se is dominantly as Se(0) despite Se K-edge XANES spectroscopy cannot easily distinguish between elemental Se and Se(-I)-bearing selenides. EXAFS spectra indicate that Se is located within aperiodic domains, markedly different to these known in monoclinic red selenium. However, Se can well occur within nanodivided domains related to monoclinic red Se, as this form was optically observed at the rim of some sludges. Aqueous selenate is then efficiently bio-reduced, under sulfate reducing and methanogenic conditions.

NTIS

*Biofilms; Biomass; Bioreactors; Fuels; Selenium; Sludge*

**20070013922** National Health and Environmental Effects Research Lab., Narragansett, RI, USA, Computer Sciences Corp., Narragansett, RI, USA

**Relationship Between Land-Based Nitrogen Loading and Eelgrass Extent for Embayments in Southern New England: Initial Model Construction**

Charpentier, M.; Mar. 2007; 47 pp.; In English

Report No.(s): PB2007-107189; EPA/600/R-07/021; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report outlines research results of the US EPA Atlantic Ecology Division in fulfilling the National Health and Environmental Effects Laboratory's Aquatic Stressors Nutrient Programs charge to develop nutrient load-ecological response models useful in setting loading limits protective of estuarine designated uses. The results reveal that eelgrass extent is significantly related ( $r(\text{sup } 2) = 0.82$ ,  $p < 0.0001$ ) to land-based nitrogen loading when estuarine volume and flushing time are considered. Once this preliminary model is revised and validated, it can be used by local, state and tribal resource managers as part of the weight of evidence required to set nitrogen loading thresholds protective of eelgrass habitat for the class of estuaries defined as southern New England shallow embayments.

NTIS

*Estuaries; Habitats; New England (US); Nitrogen*

**20070013938** Virginia Univ., Charlottesville, VA, USA

**Investigation of the Corrosion Propagation Characteristics of New Metallic Reinforcing Bars**

Scully, J. R.; Hurley, M. F.; Feb. 2007; 63 pp.; In English

Report No.(s): PB2007-107251; No Copyright; Avail.: CASI: [A04](#), Hardcopy

The threshold chloride concentrations for solid 316LN stainless steel, 316L stainless steel clad, 2101 LDX duplex stainless steel, MMFX-2 (Fe-9%Cr), and carbon steel (ASTM A615) rebars were investigated through laboratory tests in saturated Ca(OH)<sub>2</sub> + NaCl solutions.

NTIS

*Corrosion; Steels; Bridges (Structures); Stainless Steels*

**20070013958** Los Alamos National Lab., NM USA

**Plutonium and Neptunium Speciation and Mobility in Soils and the Subsurface**

Stout, S. A.; Reily, S. D.; New, M. P.; Jun. 01, 2006; 12 pp.; In English

Report No.(s): DE2006-896427; LA-UR-06-8338; No Copyright; Avail.: National Technical Information Service (NTIS)

The DOE is conducting cleanup and stabilization activities at its nuclear weapons development sites, many of which have accumulated plutonium in soils for 60 years. To properly control Pu migration in soils and groundwaters within Federal sites and onto public lands, better evaluate the public risk, and design effective remediation strategies, a fundamental understanding of Pu speciation and environmental transport is needed. The DOE is increasingly relying on monitored natural attenuation (MNA) for site stewardship. While this is practical, and defensible based on fundamental actinide chemistry and most environmental data, there are significant gaps in the foundation of the approach. Key among them is the inability to project migration rates and redistribution of actinide contaminants, particularly given the diversity and heterogeneity of sites. Matrix sorption/desorption processes are the main factors that determine contaminant transport, but little data of this type are available for Pu or Np with minerals and sediments. To support MNA and predictive geochemical models we conducted the following

research: (1) Studied environmentally relevant Pu and Np species. (2) Determined the mechanisms and thermodynamics of interactions of Pu and Np species with Mn and Fe (oxy)hydroxides and with sediments, including actinide sorption/desorption during mineral formation and redox cycling.

NTIS

*Mobility; Neptunium; Plutonium; Radioactive Wastes; Soils; Waste Management*

**20070014594** Lawrence Livermore National Lab., Livermore, CA USA

**Separating Metallic Beryllium from Plutonium by Selective Dissolution with Ammonium Fluoride**

Torres, R. A.; Sep. 30, 2006; 17 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896609; UCRL-TR-226596; No Copyright; Avail.: Department of Energy Information Bridge

Plutonium metal is stabilized for long-term storage by calcining to produce PuO(sub 2). However, if beryllium is present, the calcined product may have a high neutron dose rate because of the (sup 9)Be((alpha),n)(sup 12)C reaction in the finely divided oxide mixture. (At LLNL, inadvertent calcining of a mixture of (approx.) 500 g Pu/50 g Be produced a neutron source of (approx.) 5 R/hr.) Therefore, for health physics reasons, we would like a convenient procedure to remove beryllium from plutonium with high selectivity. Two reagents, sodium hydroxide and ammonium fluoride, were considered for aqueous processing. Each reagent selectively dissolves beryllium, which can be separated from the insoluble plutonium by decanting/filtering operations followed by water washes to remove the excess reagent. The washed plutonium is calcined for storage; the beryllium and wash fractions are solidified for disposal.

NTIS

*Ammonium Compounds; Beryllium; Dissolving; Fluorides; Plutonium*

**20070014615** NASA Ames Research Center, Moffett Field, CA, USA

**Chemistry Modeling for Aerothermodynamics and TPS**

Wang, Donyou; Stallcop, James R.; Dateo, Christopher e.; Schwenke, David W.; Halicioglu, Timur; Huo, winifred M.; 2nd International Planetary Probe Workshop; April 2005, pp. 75-80; In English; See also 20070014606; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

Recent advances in supercomputers and highly scalable quantum chemistry software render computational chemistry methods a viable means of providing chemistry data for aerothermal analysis at a specific level of confidence. Four examples of first principles quantum chemistry calculations will be presented. Study of the highly nonequilibrium rotational distribution of a nitrogen molecule from the exchange reaction N + N2 illustrates how chemical reactions can influence rotational distribution. The reaction C2H + H2 is one example of a radical reaction that occurs during hypersonic entry into an atmosphere containing methane. A study of the etching of a Si surface illustrates our approach to surface reactions. A recently developed web accessible database and software tool (DDD) that provides the radiation profile of diatomic molecules is also described.

Author

*Aerothermodynamics; Thermal Protection; Quantum Chemistry; Mathematical Models; Computational Chemistry*

**20070014693** California Univ., Berkeley, CA, USA

**Method for Preparing a Solid Phase Microextraction Device Using Aerogel**

Miller, F. S.; Andresen, B. D.; 6 Jun 05; 7 pp.; In English

Contract(s)/Grant(s): DE-W-7405-ENG-48

Patent Info.: Filed Filed 6 Jun 05; US-Patent-Appl-SN-11-146-562

Report No.(s): PB2007-105987; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A sample collection substrate of aerogel and/or xerogel materials bound to a support structure is used as a solid phase microextraction (SPME) device. The xerogels and aerogels may be organic or inorganic and doped with metals or other compounds to target specific chemical analytes. The support structure is typically formed of a glass fiber or a metal wire (stainless steel or kovar). The devices are made by applying gel solution to the support structures and drying the solution to form aerogel or xerogel. Aerogel particles may be attached to the wet layer before drying to increase sample collection surface area. These devices are robust, stable in fields of high radiation, and highly effective at collecting gas and liquid samples while maintaining superior mechanical and thermal stability during routine use. Aerogel SPME devices are advantageous for use in

GC/MS analyses due to their lack of interfering background and tolerance of GC thermal cycling.  
NTIS

*Aerogels; Chemical Analysis; Solid Phases; Substrates*

**20070014703** Lawrence Livermore National Lab., Livermore, CA, USA

**Modeling Complex Biological Flows in Multi-Scale Systems using the APDEC Framework**

Trebotich, D.; Jun. 24, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896571; UCRL-CONF-222419; No Copyright; Avail.: National Technical Information Service (NTIS)

We have developed advanced numerical algorithms to model biological fluids in multiscale flow environments using the software framework developed under the SciDAC APDEC ISIC. The foundation of our computational effort is an approach for modeling DNA-laden fluids as ‘bead-rod’ polymers whose dynamics are fully coupled to an incompressible viscous solvent. The method is capable of modeling short range forces and interactions between particles using soft potentials and rigid constraints. Our methods are based on higher-order finite difference methods in complex geometry with adaptivity, leveraging algorithms and solvers in the APDEC Framework. Our Cartesian grid embedded boundary approach to incompressible viscous flow in irregular geometries has also been interfaced to a fast and accurate level-sets method within the APDEC Framework for extracting surfaces from volume renderings of medical image data and used to simulate cardio-vascular and pulmonary flows in critical anatomies.

NTIS

*Blood; Fluid Flow*

**20070014712** Lawrence Livermore National Lab., Livermore, CA, USA

**Detonation Pressure Measurements on Petn**

Green, L. G.; Lee, E. L.; Jul. 23, 2006; 8 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896578; UCRL-CONF-222433; No Copyright; Avail.: Department of Energy Information Bridge

PETN is widely recognized as an example of nearly ideal detonation performance. The chemical composition is such that little or no carbon is produced in the detonation products. The reaction zone width is less than currently detectable. (h1 ns) Observations on PETN have thus become a baseline for EOS model predictions. It has therefore become important to characterize the detonation parameters as accurately as possible in order to provide the most exacting comparisons of EOS predictions with experimental results. We undertook a painstaking review of the detonation pressure measurements reported in an earlier work that was presented at the Fifth Detonation Symposium and found that corrections were required in determining the shock velocity in the PMMA witness material. We also refined the impedance calculation to account for the difference between the usual ‘acoustic’ method and the more accurate Riemann integral. Our review indicates that the CJ pressures previously reported for full density PETN require an average lowering of about 6 percent. The lower densities require progressively smaller corrections. We present analysis of the records, supporting hydrodynamic simulations, the Riemann integral results, and EOS parameter values derived from the revised results.

NTIS

*Chemical Explosions; Detonation; PETN; Pressure Measurement*

**20070014718** Faegre and Benson, LLP, Minneapolis, MN, USA

**Low Work Function Metal Complexes and Uses Thereof**

Elliott, C. M.; Bloom, C. J.; 9 Aug 04; 21 pp.; In English

Contract(s)/Grant(s): NSF-CHE-0139637

Patent Info.: Filed Filed 9 Aug 04; US-Patent-Appl-SN-10-524-126

Report No.(s): PB2007-105992; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention provides conductive metal-ligand coordination complexes that are useful in a variety of electronic devices. For example, such complexes are useful in organic light emitting devices composed of one or more layers of organic material between two conductors. The use of metal-ligand coordination complexes of the present invention as the cathode, replaces the more typically employed reactive metals, which function as the electron injecting contact, and provides for improved or longer-lived devices.

NTIS

*Complex Compounds; Electronic Equipment; Work Functions*



**20070014721** Environmental Protection Agency, Cincinnati, OH USA

**Metals Adsorption Workshop. Held in Cincinnati, Ohio on May 5-6, 1998**

Sep. 1998; 78 pp.; In English; Metals Adsorption Workshop, May 5 - 6, 1998, Cincinnati, Ohio  
Report No.(s): PB2007-107048; EPA/600/R-98/127; No Copyright; Avail.: CASI: [A05](#), Hardcopy

This interactive workshop with 38 participants from industry, academia and government was held May 5-6, 1998, in Cincinnati, Ohio. The purpose of the workshop was to evaluate the state of the art for ion exchange and to project applicability of advanced adsorption systems to industrial needs. The participants shared information associated with industry segments and their process and waste streams which could benefit from appropriate adsorption technology. Facilitated discussion groups were utilized to identify research required to guide technology development in the future. This document represents summary material from the presentations and discussion during the workshop. It does not constitute actual proceedings, since the presentations were informal and no written versions were required. The list of participants and contact information is included as an appendix.

NTIS

*Adsorption; Ion Exchanging; Metals*

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**METALS AND METALLIC MATERIALS**

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

**20070013815** Hartman and Hartman, P.C., Vaiparaiso, IN, USA, General Electric Co., Schenectady, NY, USA

**NK-Base Superalloy Having a Thermal Barrier Coating System**

Pfaendtner, J. A.; Schorr, D. A.; Darolia, R.; Rigney, J. D.; Walston, W. S.; 19 Dec 03; 8 pp.; In English  
Contract(s)/Grant(s): F33615-98-C-2893

Patent Info.: Filed Filed 19 Dec 03; US-Patent-Appl-SN-10-707 543

Report No.(s): PB2007-103120; No Copyright; Avail.: CASI: [A02](#), Hardcopy

An article and TBC coating system thereon that in combination exhibit significantly improved spallation resistance. The article comprises a substrate formed of a metal alloy containing ruthenium and one or more refractory elements (e.g., tantalum, tungsten, molybdenum, rhenium, hafnium, etc.). The substrate is protected by a coating system comprising an aluminum-containing bond coat on the surface of the substrate and a ceramic coating bonded to the substrate by the bond coat. The bond coat, preferably an aluminide, is deposited so as to be substantially free of ruthenium, though ruthenium is present in the bond coat as a result of diffusion from the substrate into the bond coat.

NTIS

*Gas Turbine Engines; Heat Resistant Alloys; Protective Coatings; Ruthenium Alloys; Thermal Control Coatings*

**20070013897** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Powder Processing of High Temperature Cermets and Carbides**

Salvail, Pat; Panda, Binayak; Hickman, Robert R.; Feb. 15, 2007; 22 pp.; In English; Space Technology and Applications International Forum 2007, 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013897>

The Materials and Processing Laboratory at NASA Marshall Space Flight Center is developing Powder Metallurgy (PM) processing techniques for high temperature cermet and carbide material consolidation. These new group of materials would be utilized in the nuclear core for Nuclear Thermal Rockets (NTR). Cermet materials offer several advantages for NTR such as retention of fission products and fuels, better thermal shock resistance, hydrogen compatibility, high thermal conductivity, and high strength. Carbide materials offer the highest operating temperatures but are sensitive to thermal stresses and are difficult to process. To support the effort, a new facility has been setup to process refractory metal, ceramic, carbides and depleted uranium-based powders. The facility includes inert atmosphere glove boxes for the handling of reactive powders, a high temperature furnace, and powder processing equipment used for blending, milling, and sieving. The effort is focused on basic research to identify the most promising compositions and processing techniques. Several PM processing methods

including Cold and Hot Isostatic Pressing are being evaluated to fabricate samples for characterization and hot hydrogen testing.

Author

*Cermets; Carbides; Powder Metallurgy; Fission Products; High Strength; Refractory Metals; Thermal Conductivity; Cold Pressing*

**20070013910** Nanomat, Inc., North Huntingdon, PA, USA

**Method for Manufacturing Aluminum Oxynitride (AION) Powder and Other Nitrogen-Containing Powders**

Miao, W.; 1 May 02; 3 pp.; In English

Contract(s)/Grant(s): DOD-DASG60-01-P-0088

Patent Info.: Filed Filed 1 May 02; US-Patent-Appl-SN-10-136 220

Report No.(s): PB2007-102447; No Copyright; Avail.: CASI: [A01](#), Hardcopy

A method of preparing substantially homogeneous aluminum oxynitride powder and other nitrogen-containing powders is provided. Particularly with respect to the AION powder, the method comprises the steps of milling a mixture of aluminum and aluminum oxide in a nitrogen-containing atmosphere until a milled powder composed of aluminum-nitrogen solid solution and aluminum oxide forms. The next step is heating the milled powder in the presence of an inert gas and keeping it at sufficient temperature for a sufficient heating time to form the substantially homogenous aluminum oxynitride powder. This method is extended to the preparation of other powders by employing appropriate starting materials. The resultant powders are also claimed as part of the instant invention.

NTIS

*Aluminum Nitrides; Aluminum Oxides; Manufacturing; Nitrogen; Oxynitrides; Powder (Particles); Powdered Aluminum*

**20070013921** Stanford Linear Accelerator Center, Stanford, CA, USA, National Museum of Natural History, Paris, France, Stanford Univ., CA, USA

**Adsorption Mechanisms of Trivalent Gold onto Iron Oxy-Hydroxides. From the Molecular Scale to the Model**

Cances, B.; Benedetti, M.; Farges, F.; Brown, G. E.; Nov. 01, 2006; 3 pp.; In English

Report No.(s): DE2006-896411; SLAC-PUB-12223; No Copyright; Avail.: Department of Energy Information Bridge

Gold is a highly valuable metal that can concentrate in iron-rich exogenetic horizons such as laterites. An improved knowledge of the retention mechanisms of gold onto highly reactive soil components such as iron oxyhydroxides is therefore needed to better understand and predict the geochemical behavior of this element. In this study, we use EXAFS information and titration experiments to provide a realistic thermochemical description of the sorption of trivalent gold onto iron oxy-hydroxides. Analysis of Au L(sub III)-edge XAFS spectra shows that aqueous Au(III) adsorbs from chloride solutions onto goethite surfaces as inner-sphere square-planar complexes (Au(III)(OH,Cl)(sub 4)), with dominantly OH ligands at pH  $\geq$  6 and mixed OH/Cl ligands at lower pH values. In combination with these spectroscopic results, Reverse Monte Carlo simulations were used to constraint the possible sorption sites on the surface of goethite. Based on this structural information, we calculated sorption isotherms of Au(III) on Fe oxy-hydroxides surfaces, using the CD-MUSIC (Charge Distribution--Multi Site Complexation) model. The various Au(III)-sorbed species were identified as a function of pH, and the results of these EXAFS+CD-MUSIC models are compared with titration experiments. The overall good agreement between the predicted and measured structural models shows the potential of this combined approach to better model sorption processes of transition elements onto highly reactive solid surfaces such as goethite and ferrihydrite.

NTIS

*Adsorption; Geochemistry; Gold; Hydroxides; Iron; Scale Models*

**20070013928** ALSTOM Power, Inc., Windsor, CT, USA, Babcock and Wilcox Co., Alliance, OH, USA, Oak Ridge National Lab., TN USA, Electric Power Research Inst., Palo Alto, CA, USA

**Boiler Materials for Ultrasupercritical Coal Power Plants. Fourth Quarterly Report for FY 2006, July 1 to September 30, 2006**

Voswamathan, R.; Coleman, K.; Shingledecker, J.; Sarver, J.; Stanko, G.; Oct. 20, 2006; 47 pp.; In English

Contract(s)/Grant(s): DE-FG2601NT41175

Report No.(s): DE2006-895633; No Copyright; Avail.: National Technical Information Service (NTIS)

The U.S. Department of Energy (DOE) and the Ohio Coal Development Office (OCDO) have recently initiated a project aimed at identifying, evaluating, and qualifying the materials needed for the construction of the critical components of coal-fired boilers capable of operating at much higher efficiencies than current generation of supercritical plants. This



increased efficiency is expected to be achieved principally through the use of ultrasupercritical steam conditions (USC). A limiting factor in this can be the materials of construction. The project goal is to assess/develop materials technology that will enable achieving turbine throttle steam conditions of 760oC (1400oF)/35 MPa (5000 psi). This goal seems achievable based on a preliminary assessment of material capabilities. The project is further intended to build further upon the alloy development and evaluation programs that have been carried out in Europe and Japan. Those programs have identified ferritic steels capable of meeting the strength requirements of USC plants up to approximately 620oC (1150oF) and nickel-based alloys suitable up to 700oC (1300oF). In this project, the maximum temperature capabilities of these and other available high-temperature alloys are being assessed to provide a basis for materials selection and application under a range of conditions prevailing in the boiler. This report provides a quarterly status report for the period of July 1 to September 30, 2006.

NTIS

*Boilers; Coal; Nickel Alloys; Power Plants; Mechanical Properties*

**20070013932** Fleet Technology Ltd., Kanata, Ontario, Canada

**In-Service Performance of Aluminum Structural Details**

Kramer, R.; Nov. 01, 2006; 104 pp.; In English

Report No.(s): PB2007-107217; SR-1444; No Copyright; Avail.: National Technical Information Service (NTIS)

The primary objective of the project was to compare and evaluate the design criteria and standards currently used in naval and commercial ships for the hull and structural members. This report reviewed the basic concepts in several current ship and structures regulations. The design of bottom structure, as both local structure and as part of the hull girder was the specific focus. We expected to identify factors of safety in either the load or strength formulations or both. As well as identify the best practices that incorporate latest models of structural behavior that are adequately validated by theory and experimentation. This will then be applied to new unified structural design ships.

NTIS

*Aluminum; Aluminum Alloys; Structural Design*

**20070014532** Northwestern Univ., Evanston, IL, USA

**Coarsening in Solid Liquid Mixtures-2 (CSLM-2)**

Voorhees, Peter; International Space Station Research Summary Through Expedition 10; September 2006, pp. 39; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Coarsening is an increase in the size of grains in a metal, usually during heating at elevated temperatures. The process occurs in nearly any two-phase mixture ranging from raindrops in clouds to industrial metallic alloys. It is important in industry because it affects the strength of metal alloys. The objective of the Coarsening in Solid Liquid Mixtures-2 (CSLM-2) experiment was to assess the validity of the theory of coarsening that has been used to design materials. By operating on ISS, all material transport phenomena besides coarsening are eliminated, allowing the science team to focus on the effects of coarsening alone. During cooling of an alloy of several metals, the different constituent metals may cool at different rates, causing competitive particle growth a process called Ostwald ripening. During Ostwald ripening, coarsening occurs with large particles growing at the expense of smaller ones in a matrix, with the large particles stealing atoms from smaller ones. Eventually, the sample consists of a few large particles crowded around a few remaining small particles. Materials that contain a few large particles rather than many small particles are structurally weaker. In gravity, sedimentation will draw denser particles to the bottom and light particles to the top of the sample. As a result, the sample not only coarsens, it coarsens unevenly, thereby producing areas in the material that are much weaker than other areas in the material. Processing the sample in microgravity will not prevent coarsening, but it will allow researchers to observe coarsening without the phenomena of convection and sedimentation influencing the arrangement of particles in the two-phase mixtures. In CSLM-2, samples were heated inside a large, cylindrical sample chamber inside the MSG. After a sample was completed, pressurized water was pumped into the chamber to quench the sample, cooling it for removal. This system can quench samples from 185 C (365 F) (the temperature required to initiate coarsening in tin-lead [Sn-Pb] samples) to 120 C (248 F) in only six seconds.

Author

*Alloys; Transport Properties; Ostwald Ripening; Sediments; High Temperature; Metals; Microgravity*

**20070014769** Environmental Protection Agency, Cincinnati, OH, USA

**Stagnation Time, Composition, pH, and Orthophosphate Effects on Metal Leaching from Brass**

Lytle, D. A.; Schock, M. R.; Sep. 1996; 184 pp.; In English

Report No.(s): PB2007-107071; EPA/600/R-96/103; No Copyright; Avail.: CASI: [A09](#), Hardcopy

Plumbing products made of brass and similar alloys are the only lead containing materials still installed in drinking water systems and, by law, may contain up to 8% lead. Brass ranges in metal composition depending on its application. Brass is composed of approximately 60 to 80% copper, 4 to 32% zinc, 2 to 8% lead, 6% tin, and trace amounts of iron, tin, and cadmium. The relationship between alloy composition and resulting amounts of metal leached from the alloy in drinking water has not been fully established. Better understanding brass corrosion may provide information and guidance to the use of the safest materials for the production of plumbing fixtures, and optimization of corrosion control treatments. This study examined the effect of alloy composition, pH, orthophosphate, and stagnation time on the metal leached from 6 different brasses and the pure metals and make up brass (lead, copper, and zinc) in Cincinnati, Ohio, tap water.

NTIS

*Brasses; Leaching; pH; Pollution Control; Time Dependence; Water Pollution*

## 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*.

**20070013802** Lawrence Livermore National Lab., Livermore, CA USA, California Univ., San Francisco, CA, USA

#### **Pin-Deposition of Conductive Inks for Microelectrodes and Contact Via Filling**

Davidson, J. C.; Krulevitch, P. A.; Maghribi, M. N.; Hamilton, J. K.; Bennett, W. J.; 18 Dec 03; 8 pp.; In English

Contract(s)/Grant(s): DE-W-7405-ENG-48

Patent Info.: Filed Filed 18 Dec 03; US-Patent-Appl-SN-10-742 112

Report No.(s): PB2007-103137; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A system for metalization of an integrated microsystem. The system comprises providing a substrate and applying a conductive material to the substrate by taking up small aliquots of conductive material and releasing the conductive material onto the substrate to produce a circuit component.

NTIS

*Deposition; Inks; Pins; Thin Films; Transistors*

**20070013865** General Electric Co., Niskayuna, NY, USA

#### **UV Curable Coating Compositions and Uses Thereof**

Chisholm, B. J.; Cawse, J. N.; Molaison, C. A.; Brennan, M. J.; 23 Dec 03; 9 pp.; In English

Contract(s)/Grant(s): NIST-70NANB9H3038

Patent Info.: Filed Filed 23 Dec 03; US-Patent-Appl-SN-10-747 713

Report No.(s): PB2007-103118; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The present invention is directed to curable acrylate coating compositions and coated articles resulting therefrom. The curable acrylate coating composition comprises at least two polyfunctional acrylate derivatives, at least one photoinitiator and at least one nanoscale filler.

NTIS

*Acrylates; Coating; Curing; Resins; Ultraviolet Radiation*

**20070013905** Townsend and Townsend and Crew, LLP, San Francisco, CA, USA, California Univ., Oakland, CA, USA

#### **Silicon Carbide Whisker-reinforced Ceramics with Low Rate of Grain Size Increase upon Densification**

Zhan, G.; Kuntz, J. D.; Mukherjee, A. K.; 18 Dec 03; 7 pp.; In English

Contract(s)/Grant(s): DAAD19-00-1-0185

Patent Info.: Filed Filed 18 Dec 03; US-Patent-Appl-SN-10-742 636

Report No.(s): PB2007-103084; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A highly dense composite of a ceramic material and silicon carbide whiskers with grain sizes in the nano-sized range is formed by mechanical activation of the ceramic material in the form of a nano-sized powder, followed by compressing a mixture of the mechanically activated ceramic material and silicon carbide whiskers into a fused mass while passing an electric current through the mixture, preferably by electric field-assisted sintering. The nano-sized grains in the final microstructure provide the composite with superior mechanical properties, notably strength and toughness.

NTIS

*Ceramics; Densification; Grain Size; Silicon Carbides; Whisker Composites*

**20070013918** Stanford Linear Accelerator Center, CA, USA, Stanford Univ., CA, USA, Paul Scherrer Inst., Villigen, Switzerland

**Coordination of Actinides and Fission Products in Silicate Glasses**

Haddi, A.; Farges, F.; Trocellier, P.; Curti, E.; Harfouche, M.; Nov. 01, 2006; 3 pp.; In English

Report No.(s): DE2006-896406; SLAC-PUB-12229; No Copyright; Avail.: Department of Energy Information Bridge

The local structure around Th, U, Ce and Nd in leached silicate glasses was examined using XAFS spectroscopy at their L3 edges and also at the K edge of Fe, Co, Ni, Zr and Mo. Pellets of inactive borosilicate glasses with a simplified or a complex composition were leached statically at 90 C, at pH buffered to 0 or 6 for 28 days (surface/volume, S/V, ratios of 0.1 cm(sup -1)). These glasses are compared to another SON68 sample (denoted 'SP1' in this paper) that was statically leached for 12 years under similar conditions, except for a higher S/V of 12 cm(sup -1) and a higher unconstrained pH of 9.6. The speciation of Fe, Co, Ni, Zr and Mo in the simple and the complex unleached are similar. In the statically leached glasses, the speciation of these transition metals is mostly identical to in the unleached glasses, except in the gels formed at the surface of the glasses leached at low pH, where large speciation differences are observed. Surface precipitates, especially for Fe (as ferrihydrite), Mo (possibly sidwillite) and Th (as ThO(sub 2)) were detected. Finally, the drying of the gels considerably affects the metal speciation by enhancing metal polymerization.

NTIS

*Actinide Series; Borosilicate Glass; Coordination; Fission Products; Glass; Radioactive Wastes; Silicates; Waste Management*

**20070013920** Stanford Linear Accelerator Center, CA, USA, European Synchrotron Radiation Facility, Grenoble, France, National Museum of Natural History, Paris, France

**Discovery of Unusual Minerals in Pleolithic Black Pigments from Lascaux (France) and Ekain (Spain)**

Chalmin, E.; Farges, F.; Vignaud, C.; Susini, J.; Menu, M.; Nov. 01, 2006; 3 pp.; In English

Report No.(s): DE2006-896410; SLAC-PUB-12224; No Copyright; Avail.: Department of Energy Information Bridge

Analyses of archaeological materials aim to rediscover the know-how of Prehistoric people by determining the nature of the painting matter, its preparation mode, and the geographic origin of its raw materials. This study deals with identification of manganese oxides in black pigments by micro-XANES (X-ray absorption near-edge structure) based on previous TEM (transmission electron microscopy) studies. Complex mixtures of the manganese oxides studied are present in some of mankind's oldest known paintings, namely those from the caves of Lascaux (Dordogne, France) and Ekain (Basque country, Spain). Scarce manganese oxide minerals, including groutite, hausmannite, and manganite, were found for the first time in Paleolithic art at these archaeological sites. Because there are no known deposits of such minerals in these areas, more distant origins and trade routes are inferred. The closest known Mn-rich geological province for Lascaux is the central Pyrenees, which is (approx) 250 km from the Dordogne area.

NTIS

*Archaeology; France; Minerals; Pigments; Spain*

**20070014575** Lawrence Livermore National Lab., Livermore, CA USA, Los Alamos National Lab., NM USA

**Multiple Quantum NMR Investigations of Structure Property Relationships in Synthetic and Aged Silicone Elastomers**

Maxwell, R.; Gjersing, E.; Chinn, S.; Herberg, J.; Eastwood, E.; Oct. 03, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896591; UCRL-PROC-224977; No Copyright; Avail.: Department of Energy Information Bridge

Complex engineering elastomeric materials are often characterized by a complex network structure obtained by crosslinking network chains with multiple chain lengths. Further, these networks are commonly filled with thixotropic reinforcing agents such as SiO(sub 2) or carbon black. Degradation of such materials often occurs via mechanisms that alter the fundamental network structure. In order to understand the effects of modifications of network structure and filler-polymer interaction on component performance, a series of model compounds have been studied by (sup 1)H multiple quantum NMR analysis and traditional mechanical property assessments. The (sup 1)H NMR data provides insight into the distribution of segmental dynamics that reveals insight into the changes in mechanical properties.

NTIS

*Elastomers; Silicones; Mechanical Properties*

## 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*.

**20070013771** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **Investigation of Ruthenium Dissolution in Advanced Membrane Electrode Assemblies for Direct Methanol Based Fuel Cell Stacks**

Valdez, Thomas I.; Firdosy, S.; Koel, B. E.; Narayanan, S. R.; October 19, 2005; 19 pp.; In English; 208th Meeting of the Electrochemical Society (ECS), 19 Oct. 2005, Los Angeles, CA, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39695>

Dissolution of ruthenium was observed in the 80-cell stack. Duration testing was performed in single cell MEAs to determine the pathway of cell degradation. EDAX analysis on each of the single cell MEAs has shown that the Johnson Matthey commercial catalyst is stable in DMFC operation for 250 hours, no ruthenium dissolution was observed. Changes in the hydrophobicity of the cathode backing papers was minimum. Electrode polarization analysis revealed that the MEA performance loss is attributed to changes in the cathode catalyst layer. Ruthenium migration does not seem to occur during cell operation but can occur when methanol is absent from the anode compartment, the cathode compartment has access to air, and the cells in the stack are electrically connected to a load (Shunt Currents). The open-to-air cathode stack design allowed for: a) The MEAs to have continual access to oxygen; and b) The stack to sustain shunt currents. Ruthenium dissolution in a DMFC stack can be prevented by: a) Developing an internally manifolded stacks that seal reactant compartments when not in operation; b) Bringing the cell voltages to zero quickly when not in operation; and c) Limiting the total number of cells to 25 in an effort to limit shunt currents.

Derived from text

*Fuel Cells; Methanol; Ruthenium; Degradation; Electrolytic Cells; Hydrophobicity; Cathodes*

## 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*.

**20070013992** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **The Microgravity Science Glovebox (MSG), a Resource for Gravity-Dependent Phenomena Research on the International Space Station (ISS)**

Spivey, Reggie A.; Jeter, Linda B.; Vonk, Chris; [2007]; 1 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA

Contract(s)/Grant(s): NAS8-02060; Copyright; Avail.: Other Sources; Abstract Only

The Microgravity Science Glovebox (MSG) is a double rack facility aboard the International Space Station (ISS) designed for gravity-dependent phenomena investigation handling. The MSG has been operating in the ISS US Laboratory Module since July 2002. The MSG facility provides an enclosed working area for investigation manipulation and observation in the ISS. The MSG's unique design provides two levels of containment to protect the ISS crew from hazardous operations. Research investigations operating inside the MSG are provided a large 255 liter work volume, 1000 watts of dc power via a versatile supply interface (120,28, plus or minus 12, and 5 Vdc), 1000 watts of cooling capability, video and data recording and real time downlink, ground commanding capabilities, access to ISS Vacuum Exhaust and Vacuum Resource 'Systems, and gaseous nitrogen supply. With these capabilities, the MSG is an ideal platform for research required to advance the technology readiness levels (TRL) needed for the Crew Exploration Vehicle and the Exploration Initiative. Areas of research that will benefit from investigations in the MSG include thermal management, fluid physics, spacecraft fire safety, materials science, combustion and reacting control systems, in situ fabrication and repair, and advanced life support technologies. This paper will provide a detailed explanation of the MSG facility, a synopsis of the research that has already been accomplished in the MSG, an overview of investigations planning to operate in the MSG, and possible augmentations that can be added

to-the MSG facility to further enhance the resources provided to investigations.

Author

*Fabrication; International Space Station; Microgravity; Research and Development; Test Facilities*

**20070014065** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Gas-Liquid Separation Strategies in Microgravity Environment**

Antar, Basil N.; Reiss, Donald A.; Lehman, Daniel; [2006]; 1 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2006, Reno, NV, USA; Copyright; Avail.: Other Sources; Abstract Only

Bubble entrainment in liquids represents a serious problem in the microgravity environment. Whenever bubbles are entrained in a liquid, they tend to remain stationary in the liquid bulk in the absence of any external forcing. This is due to the reduction or complete absence of the buoyancy force in the microgravity environment, Thus the buoyancy force can not be exploited to place the bubbles at the top of the liquid volume as in  $I_g$  conditions. This situation represents a serious drawback in many space based engineering and scientific applications. We have demonstrated in a series of low gravity experiments conducted during parabolic flight on board aircraft that bubbles can be controlled in such a manner as to increase the probability of their expulsion from a liquid bulk. In these tests the liquid bulk was made either to be contained within, or to flow through specially designed containers using capillary force alone. Such containers appear to facilitate bubble removal, from the liquid bulk. Different successful liquid flow configurations will be discussed and the efficacy of the resulting bubble expulsion mechanisms will be demonstrated.

Author

*Bubbles; Entrainment; Liquids; Microgravity; Gas-Liquid Interactions; Expulsion*

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**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*.

**20070013759** Naval War Coll., Newport, RI USA

**Command and Control of U.S. Sealift: Strength or Achilles Heel?**

Barrett, Sam C; Oct 23, 2006; 26 pp.; In English

Report No.(s): AD-A463371; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463371>

This study evaluates the command and control (C2) of U.S. sealift forces as measured against a generic near-peer adversary in 2018. The study begins with a vignette in which an enemy employs a creative operational scheme to delay U.S. power projection capability. This scenario forms the point of reference from which several weaknesses in U.S. sealift C2 capability are identified. The study offers a strategic context from which a similar scenario might develop in the future. The first section details U.S. National Sealift capability. The second section addresses C2 of U.S. sealift. Three elements of C2 are identified as potential critical vulnerabilities -- unity of command, interoperability, and in-transit visibility. The final section offers specific suggestions to reduce vulnerabilities vis- -vis an enemy attack. It also offers an important mindset shift that must take place within logistical circles to help U.S. C2 capability withstand likely attack against sealift forces in the future. The intent of this study is to raise the awareness of military leaders to significant vulnerabilities within U.S. power projection capability, and to suggest logical actions to reduce those vulnerabilities before an enemy can exploit them in the future.

DTIC

*Command and Control; Military Operations*

**20070013816** Motorola, Inc., Libertyvill, IL, USA

**Method and Apparatus for Determining the Location of a Unit Using Neighbor Lists**

Niu, F.; Kyperountas, S.; Martin, F. L.; Huang, J.; Shi, Q.; 23 Dec 03; 10 pp.; In English

Contract(s)/Grant(s): NIST-70NANB2H3001

Patent Info.: Filed Filed 23 Dec 03; US-Patent-Appl-SN-10-743 961

Report No.(s): PB2007-103088; No Copyright; Avail.: CASI: A02, Hardcopy

A method and location determination module is provided for determining a location of one of a plurality of units using neighbor lists. Each unit is communicatively coupled to at least some of the other plurality of units, where at least some of



the plurality of units are reference units, whose locations are known. The units communicate with other nearby units within communication range, to establish neighbor lists. A unit to be located then identifies an aggregate value corresponding to the number of occurrences of the reference units in the neighbor list of the unit to be located and the neighbor lists of each of a group of associated units. The location of the unit to be located is then determined, based upon the known locations of the reference units and the number of identified occurrences of the reference units in the corresponding neighbor lists.

NTIS

*Position (Location); Telecommunication; Methodology*

**20070013817** Oliff and Berridge, PLC, Alexandria, VA, USA, Palo Alto Research Center, Inc., Palo Alto, CA, USA  
**Systems and Methods for Characterizing the Coverage of ad hoc Sensor Networks**

Liu, J.; Koutsoukos, X.; 17 Dec 03; 14 pp.; In English

Contract(s)/Grant(s): DARPA- F30602-00-C-0139

Patent Info.: Filed Filed 17 Dec 03; US-Patent-Appl-SN-10-736 601

Report No.(s): PB2007-103089; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The systems and methods according to this invention disclose that coverage for an ad hoc sensor network is fundamental to the deployment and utilization of such networks. The invention provides a method which characterizes the coverage of an ad hoc sensor network by defining a sensing field over the space within which the physical phenomenon of interest occurs. Its value at any given point reflects the ability of the sensor network to estimate the phenomenon and/or event, of interest at this point. A statistical method is presented to determine such a field based on sensor layouts and sensor models. The system and methods of the invention define well monitored regions and sensor holes, information that can be used to characterize the quality of service that the network provides for different applications. A graphical user interface may be provided to display this information to the user for monitoring in health management of the network. The systems and methods of the invention apply to fixed as well as mobile sensors.

NTIS

*Graphical User Interface; Sensors; Communication Networks; Characterization*

**20070013824** Shumaker and Sieffert, P.A., Saint Paul, MN, USA

**Receiver for Chip-interleaved Block-spread Multi-user Communication Systems**

Giannakis, G. B.; Zhou, S.; 7 May 04; 27 pp.; In English

Contract(s)/Grant(s): NSF-CCR-0105612; DAAD19 01-2-0011

Patent Info.: Filed Filed 7 May 04; US-Patent-Appl-SN-10-841 806

Report No.(s): PB2007-103096; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Techniques are described for performing block equalization on a received wireless communication signal formed according to interleaved chips generated from sub-blocks of symbols. For example, a one-step block equalization process is described which produces estimates of the information-bearing symbols from a wireless communication signal received from two or more transmitters in a soft handoff environment. The techniques provide improved performance in high load, soft handoff environments with low complexity, highly flexible equalization. The wireless communication signal may be a CIBS-CDMA signal in which a symbol block is divided into sub-blocks and spread by a user-specific block-spreading matrix. The CIBS signal is received through M subchannels and a de-spreading matrix is applied to produce a multi-user interference (MUI) free sub-block output for the m.sup.th channel. One-step block equalization comprises forming a single block from the m de-spread sub-blocks and performing block equalization on the single block.

NTIS

*Receivers; Telecommunication; Wireless Communication; Chips (Electronics)*

**20070013871** Alabama Univ., Birmingham, AL, USA

**Research and Proposal Savvy via Distance Learning (Research and Proposal Preparation Skills for Military Nurses: RAPPS)**

Turner, J. C.; Oct. 2001; 10 pp.; In English

Contract(s)/Grant(s): N98-P15; MDA 905-98-Z-0039

Report No.(s): PB2007-107656; Copyright; Avail.: National Technical Information Service (NTIS)

The purpose of this project was to create, implement, and evaluate an asynchronous distance-learning course designed to improve military nurses grant preparation and proposal development skills and enable them to successfully compete for external funding. The intent was to establish a Web-based program that would provide instruction in material that was

previously taught in TriService Nursing Research Program (TSNRP) on-site workshops. The Proposal Preparation Skills for Military Nurses (RAPPS) course included a 26-week pilot course offered to six students and a full 39-week course offered three different times to a total of 82 enrolled participants. However, only a total of 15 participants actually completed all course requirements, which included preparing a rudimentary research proposal. A total of nine students succeeded in preparing a research proposal to submit in response to a request for proposals announced by TSNRP.

NTIS

*Medical Personnel; Synchronism; Education; Military Personnel*

**20070014716** Christian [Stephen R.], Idaho Falls, ID, USA

**Method and System for Pipeline Communication**

Richarson, J. G.; 14 Apr 04; 10 pp.; In English

Contract(s)/Grant(s): DE-AC07-99ID13727

Patent Info.: Filed Filed 14 Apr 04; US-Patent-Appl-SN-10-825-804

Report No.(s): PB2007-105991; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A pipeline communication system and method includes a pipeline having a surface extending along at least a portion of the length of the pipeline. A conductive bus is formed to and extends along a portion of the surface of the pipeline. The conductive bus includes a first conductive trace and a second conductive trace with the first and second conductive traces being adapted to conformally couple with a pipeline at the surface extending along at least a portion of the length of the pipeline. A transmitter for sending information along the conductive bus on the pipeline is coupled thereto and a receiver for receiving the information from the conductive bus on the pipeline is also couple to the conductive bus.

NTIS

*Communication Equipment; Pipelines*

### 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*.

**20070013757** Greenless Winnter and Sullivan P C., Boulder, CO, USA

**Mis-Based Sensors with Hydrogen Selectivity**

Li, D.; Medlin, W.; McDaniel, A. H.; Bastasz, R. J.; 24 Feb 06; 24 pp.; In English

Contract(s)/Grant(s): DE-AC04-94AL85000

Patent Info.: Filed Filed 24 Feb 06; US-Patent-Appl-SN-11-361-310

Report No.(s): PB2007-101677; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The invention provides hydrogen selective metal-insulator-semiconductor sensors which include a layer of hydrogen selective material. The hydrogen selective material can be polyimide layer having a thickness between 200 and 800 nm. Suitable polyimide materials include reaction products of benzophenone tetracarboxylic dianhydride 4,4-oxydianiline m-phenylene diamine and other structurally similar materials.

NTIS

*Hydrogen; Patent Applications; Semiconductors (Materials)*

**20070013807** Swedish Defence Research Establishment, Linkoeeping, Sweden

**Reconfiguration of ERP in Broadband Phased Arrays Using Frequency Dependent Taper (Rekonfigurering av PG-Produkt i Bredbandiga Gruppantenner Anvaendande Frekvensberoende Tapering)**

Holmgren, T.; Ouacha, A.; Gunnarsson, R.; Aug. 2005; 16 pp.; In English

Report No.(s): PB2007-103415; FOI-R-1693-SE; No Copyright; Avail.: National Technical Information Service (NTIS)

In this report, the possibility for control of the radiation from a broadband array by a frequency dependent taper of the aperture area is explored, with focus on used power and radiated power density in the main lobe. The desire for a frequency independent lobewidth is assumed, but the optimal frequency dependence of other parameters such as antenna gain is not obvious, something which is briefly discussed. The feasibility of a flexible, broadband, antenna array with frequency dependence of other parameters such as antenna gain is not obvious, something which is briefly discussed. The feasibility of a flexible, broadband antenna array with frequency independent features is demonstrated, indicating the usefulness of tunable



low pass filters and amplifiers. This would allow low frequency components to use a larger part of the aperture, and thus keep radiation characteristics frequency independent. A frequency independent lobe-width in electronic warfare applications would ensure that less power is wasted in undesirable directions, conserving power and decreasing the likelihood of hitting the unintended targets. The later part of the report is devoted to components in a possible realization of a flexible beam-former. Examples of a time delay and a power splitter/power combiner are presented.

NTIS

*Broadband; Frequencies; Phased Arrays; Tapering*

**20070013858** Aerospace Corp., El Segundo, CA, USA

**Annular Segmented Mosfet**

Mayer, D. C.; Osborn, J. V.; Laco, R. C.; King, E. E.; 1 Dec 03; 8 pp.; In English

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

Patent Info.: Filed Filed 1 Dec 03; US-Patent-Appl-SN-10-725 685

Report No.(s): PB2007-102437; No Copyright; Avail.: CASI: [A02](#), Hardcopy

An annular segment MOSFET structure has reduced drain electric fields for a given applied voltage and dimensional sizing for improved reliability from damage by reducing high energy hot carriers laterally traversing the channel by reducing the intensity of electric fields in the MOSFET structure by creating diverging electric field lines with decreased electric field strength at the drain, while enabling compact integrated layouts of multiple MOSFETs within a square area of surface silicon.

NTIS

*Field Effect Transistors; Segments; Semiconductors (Materials); Electric Fields*

**20070013874** Grant Prideco, L.P., Houston, TX, USA

**Seal for Coaxial Cable in Downhole Tools**

Hall, D. R.; Hall, T.; Pixton, D. S.; Dalgren, S.; 28 Nov 03; 16 pp.; In English

Contract(s)/Grant(s): DE-FC26-97FT343656

Patent Info.: Filed Filed 28 Nov 03; US-Patent-Appl-SN-10-707 232

Report No.(s): PB2007-102471; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A seal for a coaxial cable electrical connector more specifically an internal seal for a coaxial cable connector placed within a coaxial cable and its constituent components. A coaxial cable connector is in electrical communication with an inductive transformer and a coaxial cable. The connector is in electrical communication with the outer housing of the inductive transformer. A generally coaxial center conductor, a portion of which could be the coil in the inductive transformer, passes through the connector, is electrically insulated from the connector, and is in electrical communication with the conductive core of the coaxial cable. The electrically insulating material also doubles as a seal to safeguard against penetration of fluid, thus protecting against shorting out of the electrical connection. The seal is a multi-component seal, which is pre-compressed to a desired pressure rating. The coaxial cable and inductive transformer are disposed within downhole tools to transmit electrical signals between downhole tools within a drill string. The internal coaxial cable connector and its attendant seal can be used in a plurality of downhole tools, such as sections of pipe in a drill string, drill collars, heavy weight drill pipe, and jars.

NTIS

*Coaxial Cables; Electric Connectors; Seals (Stoppers)*

**20070013878** Lumen Intellectual Property, Palo Alto, CA, USA

**Superconductive Contacts with Hydroxide-catalyzed Bonds that Retain Superconductivity and Provide Mechanical Fastening Strength**

Mester, J.; Gwo, D.; June 23, 2005; 10 pp.; In English

Contract(s)/Grant(s): NAS8-39225

Patent Info.: Filed Filed 21 May 04; US-Patent-Appl-SN-10-850 857

Report No.(s): PB2007-103140; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013878>

A superconductive contact or contact structure composed mainly of superconductors and a hydroxide-catalyzed bond that establishes electrical contacts, retains superconductivity, and provides the full mechanical fastening strength between the superconductors. According to the present invention, the superconductive contact structure exhibits a single-film superconductive behavior. In some embodiments, the structure has a configuration of two metallic low critical-temperature (low-T<sub>sub.c</sub>) superconductors, such as niobium (Nb), connectorized by an essentially transparent and extremely thin

hydroxide-catalyzed bond. In some embodiments, two ceramic high critical-temperature (high-T<sub>sub.c</sub>) superconductors, such as perovskite ceramics (e.g., YBa<sub>sub.2</sub>Cu<sub>sub.3</sub>O<sub>sub.7</sub> or YBCO in general) are joined via a hydroxide-catalyzed bond. In some embodiments, a metallic low-T<sub>sub.c</sub> superconductor and a ceramic high-T<sub>sub.c</sub> superconductor is connectorized via a hydroxide-catalyzed bond.

Author

*Bonding; Catalysis; Fasteners; Hydroxides; Superconductivity*

**20070013881** Steptoe and Johnson LLP, Washington, DC, USA

**Biological Applications of Quantum Dots**

Bawendi, M. G.; Sundar, V. C.; Mikulec, F. V.; 3 Nov 04; 23 pp.; In English

Contract(s)/Grant(s): NSF-DMR-9400334

Patent Info.: Filed Filed 3 Nov 04; US-Patent-Appl-SN-10-979 241

Report No.(s): PB2007-102463; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention provides a composition comprising fluorescent semiconductor nanocrystals associated to a compound, wherein the nanocrystals have a characteristic spectral emission, wherein said spectral emission is tunable to a desired wavelength by controlling the size of the nanocrystal, and wherein said emission provides information about a biological state or event.

NTIS

*Quantum Dots; Nanocrystals*

**20070013882** Summa and Allan, P.A., Charlotte, NC, USA

**Minimizing Degradation of SiC bipolar Semiconductor Devices**

Sumakeris, J. J.; Singh, R.; Paisley, M. J.; Mueller, S. G.; Hobgood, H. M.; 22 Dec 04; 15 pp.; In English

Patent Info.: Filed Filed 22 Dec 04; US-Patent-Appl-SN-11-022 544

Report No.(s): PB2007-102469; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A method of forming a bipolar device includes forming at least one p-type layer of single crystal silicon carbide and at least one n-type layer of single crystal silicon carbide on a substrate. Stacking faults that grow under forward operation of the device are segregated from at least one of the interfaces between the active region and the remainder of the device. The method of forming bipolar devices includes growing at least one of the epitaxial layers to a thickness greater than the minority carrier diffusion length in that layer. The method also increases the doping concentration of epitaxial layers surrounding the drift region to decrease minority carrier lifetimes therein.

NTIS

*Bipolar Transistors; Bipolarity; Degradation; Semiconductor Devices; Silicon Carbides*

**20070013900** Lowrie, Lando and Anastash, Cambridge, MA, USA, TIAXX, LLC, Cambridge, MA, USA

**Electrochemical Devices and Components Thereof**

Sriramulu, S.; Singh, A.; Thijssen, J. H.; Carlson, E.; 17 Sep 04; 16 pp.; In English

Contract(s)/Grant(s): DOC-70NANB3H3018

Patent Info.: Filed Filed 17 Sep 04; US-Patent-Appl-SN-10-944 273

Report No.(s): PB2007-102455; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An interconnect utilizing a metal matrix composite of at least one metal selected from the group consisting of copper, oxide dispersion strengthened copper, aluminum, titanium, and alloys thereof, and at least one reinforcing material selected from the group consisting of carbon, boron carbide, silicon carbide, zirconium carbide, hafnium carbide, tantalum carbide, titanium carbide, zirconium diboride, hafnium diboride, tantalum diboride, titanium diboride, silicon dioxide, aluminum oxide, alumino-silicate, silicon nitride, and aluminum nitride is disclosed. The interconnect can be utilized as a component of an electrochemical device. The interconnect can have a coefficient of thermal expansion that is within about 10% of a coefficient of thermal expansion of a component or assembly of the electrochemical device.

NTIS

*Electrochemistry; Metal Matrix Composites; Components*

**20070013902** Lawrence Livermore National Lab., Livermore, CA USA

**Planarization of Substrate Pits and Scratches**

Mikarimi, P. B.; Baker, S. L.; Stearns, D. G.; Spiller, E. A.; 12 Oct 04; 19 pp.; In English

Contract(s)/Grant(s): DE-W-7405-ENG48

Patent Info.: Filed Filed 12 Oct 04; US-Patent-Appl-SN-10-964 048

Report No.(s): PB2007-102458; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Ion-beam based deposition technique are provided for the planarization of pit and scratch defects in conjunction with particle defects. One application of this planarization technique is to mitigate the effects of pits and scratches and particles on reticles for extreme ultraviolet (EUV) lithography. In the planarization process, thin Si layers are successively deposited and etched away where the etching is directed at angles well away from normal incidence to the substrate to planarize pits and scratches without causing the particle defects to get too large; this is followed by a normal incidence etching process sequence designed primarily to planarize the particles but which will also planarize the pits and scratches to completion. The process also shows significant promise for planarizing substrate roughness.

NTIS

*Substrates; Planar Structures; Pits*

**20070013903** Wolf Greenfield and Sacks, PC, Boston, MA, USA, Harvard Coll. Observatory, Cambridge, MA, USA

**Nanosopic Wire-Based Devices and Arrays**

Lieber, C. M.; Rueckes, T.; Joselevich, E.; Kim, K.; 26 Oct 04; 26 pp.; In English

Contract(s)/Grant(s): NIH-GM-30367

Patent Info.: Filed Filed 26 Oct 04; US-Patent-Appl-SN-10-973 665

Report No.(s): PB2007-102441; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Electrical devices comprised of nanoscopic wires are described, along with methods of their manufacture and use. The nanoscopic wires can be nanotubes, preferably single-walled carbon nanotubes. They can be arranged in crossbar arrays using chemically patterned surfaces for direction, via chemical vapor deposition. Chemical vapor deposition also can be used to form nanotubes in arrays in the presence of directing electric fields, optionally in combination with self-assembled monolayer patterns. Bistable devices are described.

NTIS

*Electric Equipment; Electric Wire; Arrays; Nanotechnology; Carbon Nanotubes*

**20070013904** Hewlett-Packard Co., Fort Collins, CO, USA

**Methods of Bridging Lateral Nanowires and Device using same**

Islam, M. S.; Kamins, T. I.; Sharma, S.; 17 Dec 03; 26 pp.; In English

Contract(s)/Grant(s): MDA-972-01-3-0005

Patent Info.: Filed Filed 17 Dec 03; US-Patent-Appl-SN-10-738 176

Report No.(s): PB2007-102980; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A semiconductor nanowire is grown laterally. A method of growing the nanowire forms a vertical surface on a substrate, and activates the vertical surface with a nanoparticle catalyst. A method of laterally bridging the nanowire grows the nanowire from the activated vertical surface to connect to an opposite vertical surface on the substrate. A method of connecting electrodes of a semiconductor device grows the nanowire from an activated device electrode to an opposing device electrode. A method of bridging semiconductor nanowires grows nanowires between an electrode pair in opposing lateral directions. A method of self-assembling the nanowire bridges the nanowire between an activated electrode pair. A method of controlling nanowire growth forms a surface irregularity in the vertical surface. An electronic device includes a laterally grown nano-scale interconnection.

NTIS

*Nanotechnology; Nanowires; Semiconductor Devices*

**20070013907** Blank Rome, LLP, Washington, DC, USA

**Piezoelectric Vibration Energy Harvesting Device**

Deng, K. K.; Andic, K.; 11 Jan 05; 9 pp.; In English

Contract(s)/Grant(s): N00178-03-C-3056

Patent Info.: Filed Filed 11 Jan 05; US-Patent-Appl-SN-11-031 993

Report No.(s): PB2007-103085; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A piezoelectric vibration energy harvesting device which is made up of a first mass, a second, a first spring coupled to the first mass, and a second spring coupled to the second mass. A piezoelectric element is bonded between the first mass and the second spring, so that a stress applied to the second spring is applied to the piezoelectric element.

NTIS

*Energy Storage; Piezoelectricity; Vibration*

**20070013925** Schwegman, Lundberg, Woessner and Kluth, P.A., Minneapolis, MN, USA

**Parallel Transceiver for Nuclear Magnetic Resonance System**

Vaughan, J. T.; Adriany, G.; Ugurbil, K.; Strupp, J.; Andersen, P.; 4 Oct 04; 13 pp.; In English

Contract(s)/Grant(s): NIH-R01-CA-94200-01A1; NIH-P41-RR08079

Patent Info.: Filed Filed 4 Oct 04; US-Patent-Appl-SN-10-957 870

Report No.(s): PB2007-102439; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An excitation and detection circuit having individually controllable elements for use with a multi-element radio frequency coil. Characteristics of the driving signal, including, for example, the phase, amplitude, frequency and timing, from each element of the circuit is separately controllable using small signals. Negative feedback for the driving signal associated with each coil element is derived from a receiver coupled to that coil element.

NTIS

*Nuclear Magnetic Resonance; Transmitter Receivers; Electrical Engineering; Circuits*

**20070013926** Troitman Sanders, LLP, Atlanta, GA, USA

**Single Substrate Electromagnetic Actuator**

Bintoro, J. S.; Hesketh, P. J.; 31 Oct 03; 60 pp.; In English

Contract(s)/Grant(s): DARPA-F33615-01-1-2173

Patent Info.: Filed Filed 31 Oct 03; US-Patent-Appl-SN-10-699 210

Report No.(s): PB2007-102440; No Copyright; Avail.: CASI: [A04](#), Hardcopy

A microvalve which utilizes a low temperature (less than 300 C.) fabrication process on a single substrate. The valve uses buckling and an electromagnetic actuator to provide a relatively large closing force and lower power consumption. A buckling technique of the membrane is used to provide two stable positions for the membrane, and to reduce the power consumption and the overall size of the microvalve. The use of a permanent magnet is an alternative to the buckled membrane, or it can be used in combination with the buckled membrane, or two sets of micro-coils can be used in order to open and close the valve, providing the capability for the valve to operate under normally opened or normally closed conditions. Magnetic analysis using ANSYS 5.7 shows that the addition of Orthonol between the coils increases the electromagnetic force by more than 1.5 times. At a flow rate of 1 mL/m, the pressure drop is  $\approx 100$  Pa. The maximum pressure tested was 57 kPa and the time to open or close the valve in air is under 100 ms. This results in an estimated power consumption of 0.1 mW.

NTIS

*Actuators; Electromagnets; Substrates*

**20070013959** Kansas State Univ., Manhattan, KS, USA, Kansas State Univ., Manhattan, KS, USA

**Semiconductor Radiation Detectors with Frisch Collars and Collimators for Gamma Ray Spectroscopy and Imaging**

McGregor, D. S.; Kargar, A.; Harrison, M.; Brooks, A.; McNeil, W.; Dec. 01, 2006; 26 pp.; In English

Contract(s)/Grant(s): 03ID14498

Report No.(s): DE2006-896432; No Copyright; Avail.: National Technical Information Service (NTIS)

To study CdZnTe as a high energy resolution gamma ray detector with a novel new design, and to build a detector array from the new detector design.

NTIS

*Collimators; Gamma Ray Spectrometers; Imaging Techniques; Radiation Detectors; Semiconductors (Materials)*

**20070014679** Sandia National Labs., Albuquerque, NM USA

**LDRD Final Report on Si Nanocrystal as Device Prototype for Spintronics Applications**

Pan, W.; Dunn, R. G.; Carroll, M. S.; Verley, J. C.; Brewer, L. N.; Nov. 01, 2006; 28 pp.; In English

Contract(s)/Grant(s): AC04-94AL85000

Report No.(s): DE2006-896555; SAND-2006-7101; No Copyright; Avail.: National Technical Information Service (NTIS)

The silicon microelectronics industry is the technological driver of modern society. The whole industry is built upon one

major invention--the solid-state transistor. It has become clear that the conventional transistor technology is approaching its limitations. Recent years have seen the advent of magnetoelectronics and spintronics with combined magnetism and solid state electronics via spin-dependent transport process. In these novel devices, both charge and spin degree freedoms can be manipulated by external means. This leads to novel electronic functionalities that will greatly enhance the speed of information processing and memory storage density. The challenge lying ahead is to understand the new device physics, and control magnetic phenomena at nanometer length scales and in reduced dimensions. To meet this goal, we proposed the silicon nanocrystal system, because: (1) It is compatible with existing silicon fabrication technologies; (2) It has shown strong quantum confinement effects, which can modify the electric and optical properties through directly modifying the band structure; and (3) the spin-orbital coupling in silicon is very small, and for isotopic pure (sup 28)Si, the nuclear spin is zero. These will help to reduce the spin-decoherence channels. In the past fiscal year, we have studied the growth mechanism of silicon-nanocrystals embedded in silicon dioxide, their photoluminescence properties, and the Si-nanocrystal's magnetic properties in the presence of Mn-ion doping.

NTIS

*Microelectronics; Nanocrystals; Prototypes; Semiconductors (Materials); Silicon*

**20070014681** Sandia National Labs., Albuquerque, NM USA

**RF/Microwave Properties and Applications of Directly Assembled Nanotubes and Nanowires: LDRD Project 102662 Final Report**

Lee, M.; Shaner, E. A.; Hignstrete, C.; Talin, A. A.; Jones, F. C.; Nov. 01, 2006; 16 pp.; In English

Contract(s)/Grant(s): AC04-94AL85000

Report No.(s): DE2006-896556; SAND2006-7100; No Copyright; Avail.: Department of Energy Information Bridge

LDRD Project 102662 provided support to pursue experiments aimed at measuring the basic electrodynamic response and possible applications of carbon nanotubes and silicon nanowires at radiofrequency to microwave frequencies, approximately 0.01 to 50 GHz. Under this project, a method was developed to integrate these nanomaterials onto high-frequency compatible co-planar waveguides. The complex reflection and transmission coefficients of the nanomaterials was studied as a function of frequency. From these data, the high-frequency loss characteristics of the nanomaterials were deduced. These data are useful to predict frequency dependence and power dissipation characteristics in new rf/microwave devices incorporating new nanomaterials.

NTIS

*Microwave Equipment; Microwaves; Nanotubes; Radio Frequencies; Nanowires*

**20070014683** Sandia National Labs., Albuquerque, NM USA

**Micropolarizing Device for Long Wavelength Infrared Polarization Imaging**

Kemme, S. A.; Smith, J. L.; Cruz-Cabrera, A. A.; Samora, S.; Carter, T. R.; Nov. 01, 2006; 60 pp.; In English

Contract(s)/Grant(s): AC04-94AL85000

Report No.(s): DE2006-896557; SAND2006-6889; No Copyright; Avail.: National Technical Information Service (NTIS)

The goal of this project is to fabricate a four-state pixelated subwavelength optical device that enables mid-wave infrared (MWIR) or long-wave infrared (LWIR) snapshot polarimetric imaging. The polarization information can help to classify imaged materials and identify objects of interest for numerous remote sensing and military applications. While traditional, sequential polarimetric imaging produces scenes with polarization information through a series of assembled images, snapshot polarimetric imaging collects the spatial distribution of all four Stokes parameters simultaneously. In this way any noise due to scene movement from one frame to the next is eliminated. We fabricated several arrays of subwavelength components for MWIR polarization imaging applications. Each pixel unit of the array consists of four elements. These elements are micropolarizers with three or four different polarizing axis orientations. The fourth element sometimes has a micro birefringent waveplate on the top of one of the micropolarizers. The linear micropolarizers were fabricated by patterning nano-scale metallic grids on a transparent substrate. A large area birefringent waveplate was fabricated by deeply etching a subwavelength structure into a dielectric substrate. The principle of making linear micropolarizers for long wavelengths is based upon strong anisotropic absorption of light in the nano-metallic grid structures. The nano-metallic grid structures are patterned with different orientations; therefore, the micropolarizers have different polarization axes. The birefringent waveplate is a deeply etched dielectric one-dimensional subwavelength grating; therefore two orthogonally polarized waves have different phase delays. Finally, in this project, we investigated the near field and diffractive effects of the subwavelength element apertures upon detection.

NTIS

*Electronic Equipment; Infrared Imagery; Polarimetry; Remote Sensing*



**20070014720** Foley and Lardner, LLP, Chicago, VA, USA

**Housing for Electrochemical Devices**

Kaun, T. D.; 12 Apr 05; 23 pp.; In English

Contract(s)/Grant(s): NSF-DMI-0349621

Patent Info.: Filed Filed 12 Apr 05; US-Patent-Appl-SN-11-104-363

Report No.(s): PB2007-106002; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An improved housing for a rolled-ribbon electrochemical device is provided. The housing comprises a fastener that aligns first and second cups during assembly and maintains electrode contact independent of external pressure on the housing eliminating the possibility of an open circuit state for a cell. In one alternative embodiment, the fastener comprises a stem that fits into a hollow tube and resists detachment from the tube. In another alternative embodiment, the fastener comprises a stem that fits into a grommet and resists detachment from the grommet. In yet another alternative embodiment, the fastener comprises a tube that fits into a grommet and resists detachment from the grommet.

NTIS

*Electrochemistry; Electronic Equipment*

**20070014731** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**BPM Motors in Residential Gas Furnaces: What are the Savings**

Lutz, J.; Franco, V.; Lekov, A.; Wong-Parodi, G.; January 2006; 12 pp.; In English

Report No.(s): DE2007-889624; No Copyright; Avail.: National Technical Information Service (NTIS)

Residential gas furnaces contain blowers to distribute warm air. Currently, furnace blowers use either a Permanent Split Capacitor (PSC) or a Brushless Permanent Magnet (BPM) motor. Blowers account for the majority of furnace electricity consumption. Therefore, accurate determination of the blower electricity consumption is important for understanding electricity consumption of furnaces. The electricity consumption of blower motors depends on the static pressure across the blower. This paper examines both types of blower motors in non-condensing non-weatherized gas furnaces at a range of static pressures. Fan performance data is based on manufacturer product literature and laboratory tests. We use field-measured static pressure in ducts to get typical system curves to calculate how furnaces would operate in the field. We contrast this with the electricity consumption of a furnace blower operating under the DOE test procedure and manufacturer rated conditions. Furnace electricity use is also affected by operating modes that happen at the beginning and end of each furnace firing cycle. These operating modes are the pre-purge and post-purge by the draft inducer, the on-delay and off-delay of the blower, and the hot surface ignitor operation. To accurately calculate this effect, we use the number of firing cycles in a typical California house in the Central Valley of California. Cooling hours are not considered in the DOE test procedure. We also account for furnace blower use by the air conditioner and stand-by power. Overall BPM motors outperform PSC motors, but the total electricity savings are significantly less than projected using the DOE test procedure conditions. The performance gains depend on the static pressure of the household ducts, which are typically much higher than in the test procedures.

NTIS

*Aerospace Systems; Air Conditioning; Blowers; Energy Consumption; Space Heating (Buildings); Ventilation*

**20070014766** Sandia National Labs., Albuquerque, NM, USA

**Solution-Verified Reliability Analysis and Design of Bistable MEMS Using Error Estimation and Adaptivity**

Adams, B. M.; Bichon, B. J.; Eldred, M. S.; Carnes, B.; Hopiins, M. M.; Oct. 01, 2006; 114 pp.; In English

Report No.(s): DE2006-896282; SAND2006-6286; No Copyright; Avail.: National Technical Information Service (NTIS)

This report documents the results for an FY06 ASC Algorithms Level 2 milestone combining error estimation and adaptivity, uncertainty quantification, and probabilistic design capabilities applied to the analysis and design of bistable MEMS. Through the use of error estimation and adaptive mesh refinement, solution verification can be performed in an automated and parameter-adaptive manner. The resulting uncertainty analysis and probabilistic design studies are shown to be more accurate, efficient, reliable, and convenient.

NTIS

*Error Analysis; Microelectromechanical Systems; Reliability Analysis; Stability*

## 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*.

**20070013780** NASA Marshall Space Flight Center, Huntsville, AL, USA

### General Relativistic MHD Simulations of Jet Formation

Mizuno, Y.; Nishikawa, K.-I.; Hardee, P.; Koide, S.; Fishman, G. J.; [2005]; 2 pp.; In English; Gamma Ray burst in the Swift Era, 29 Nov. - 2 Dec. 2005, Washington, DC, USA; Copyright; Avail.: CASI: [A01](#), Hardcopy

We have performed 3-dimensional general relativistic magnetohydrodynamic (GRMHD) simulations of jet formation from an accretion disk with/without initial perturbation around a rotating black hole. We input a sinusoidal perturbation ( $m = 5$  mode) in the rotation velocity of the accretion disk. The simulation results show the formation of a relativistic jet from the accretion disk. Although the initial perturbation becomes weakened by the coupling among different modes, it survives and triggers lower modes. As a result, complex non-axisymmetric density structure develops in the disk and the jet. Newtonian MHD simulations of jet formation with a non-axisymmetric mode show the growth of the  $m = 2$  mode but GRMHD simulations cannot see the clear growth of the  $m = 2$  mode.

Author

*Magnetohydrodynamics; Simulation; Jet Flow; Three Dimensional Flow; Relativistic Effects*

**20070013791** Pratt and Whitney Rocketdyne, Canoga Park, CA, USA

### Space Shuttle Main Engine Low Pressure Oxidizer Turbo-Pump Inducer Dynamic Environment Characterization through Water Model and Hot-Fire Testing

Arellano, Patrick; Patton, Marc; Schwartz, Alan; Stanton, David; [2006]; 1 pp.; In English; AIAA Aerospace Sciences Meeting and Exhibits, 8 Jan. 2006, Reno, NV, USA

Contract(s)/Grant(s): NAS8-01140; No Copyright; Avail.: Other Sources; Abstract Only

The Low Pressure Oxidizer Turbopump (LPOTP) inducer on the Block II configuration Space Shuttle Main Engine (SSME) experienced blade leading edge ripples during hot firing. This undesirable condition led to a minor redesign of the inducer blades. This resulted in the need to evaluate the performance and the dynamic environment of the redesign, relative to the current configuration, as part of the design acceptance process. Sub-scale water model tests of the two inducer configurations were performed, with emphasis on the dynamic environment due to cavitation induced vibrations. Water model tests were performed over a wide range of inlet flow coefficient and pressure conditions, representative of the scaled operating envelope of the Block II SSME, both in flight and in ground hot-fire tests, including all power levels. The water test hardware, facility set-up, type and placement of instrumentation, the scope of the test program, specific test objectives, data evaluation process and water test results that characterize and compare the two SSME LPOTP inducers are discussed. In addition, dynamic characteristics of the two water models were compared to hot fire data from specially instrumented ground tests. In general, good agreement between the water model and hot fire data was found, which confirms the value of water model testing for dynamic characterization of rocket engine turbomachinery.

Author

*Dynamic Characteristics; Low Pressure; Oxidizers; Space Shuttle Main Engine; Turbine Pumps; Water; Models*

**20070013797** NASA Marshall Space Flight Center, Huntsville, AL, USA

### Initial Testing of the Stainless Steel NaK-Cooled Circuit (SNaKC)

Garber, Anne; Godfroy, Thomas; Feb. 11, 2007; 23 pp.; In English; Space Technology and Applications International Forum (STAIF), 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail.:

CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013797>

An actively pumped alkali metal flow circuit, designed and fabricated at the NASA Marshall Space Flight Center, is currently undergoing testing in the Early Flight Fission Test Facility (EFF-TF). Sodium potassium (NaK) was selected as the primary coolant. Basic circuit components include: simulated reactor core, NaK to gas heat exchanger, electromagnetic liquid metal pump, liquid metal flowmeter, load/drain reservoir, expansion reservoir, test section, and instrumentation. Operation of the circuit is based around the 37-pin partial-array core (pin and flow path dimensions are the same as those in a full core),

designed to operate at 33 kWt. This presentation addresses the construction, fill and initial testing of the Stainless Steel NaK-Cooled Circuit (SNaKC).

Author

*Circuits; Coolants; Potassium; Sodium; Stainless Steels; Fabrication; Hydraulic Test Tunnels*

**20070013873** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Microfluidic System Simulation Including the Electro-Viscous Effect**

Rojas, Eileen; Chen, C. P.; Majumdar, Alok; January 13, 2007; 7 pp.; In English; Integration and Commercialization of Micro and Nanosystems, ASME International Conference, 10-13 Jan. 2007, Sanya, Hainan, China; Original contains black and white illustrations

Report No.(s): MNC2007-21295; Copyright; Avail.: CASI: [A02](#), Hardcopy

This paper describes a practical approach using a general purpose lumped-parameter computer program, GFSSP (Generalized Fluid System Simulation Program) for calculating flow distribution in a network of micro-channels including electro-viscous effects due to the existence of electrical double layer (EDL). In this study, an empirical formulation for calculating an effective viscosity of ionic solutions based on dimensional analysis is described to account for surface charge and bulk fluid conductivity, which give rise to electro-viscous effect in microfluidics network. Two dimensional slit micro flow data was used to determine the model coefficients. Geometry effect is then included through a Poiseuille number correlation in GFSSP. The bi-power model was used to calculate flow distribution of isotropically etched straight channel and T-junction microflows involving ionic solutions. Performance of the proposed model is assessed against experimental test data.

Author

*Microfluidic Devices; Simulation; Viscous Flow; Mathematical Models; Electrokinetics; Chips (Electronics)*

**20070013978** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Evaporating Spray in Supersonic Streams Including Turbulence Effects**

Balasubramanyam, M. S.; Chen, C. P.; 2006; 12 pp.; In English; 44th AIAA Aerospace Sciences Meeting and Exhibit, 9-12 Jan. 2006, Reno, NV, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC8-200

Report No.(s): AIAA Paper 2006-1338; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013978>

Evaporating spray plays an important role in spray combustion processes. This paper describes the development of a new finite-conductivity evaporation model, based on the two-temperature film theory, for two-phase numerical simulation using Eulerian-Lagrangian method. The model is a natural extension of the T-blob/T-TAB atomization/spray model which supplies the turbulence characteristics for estimating effective thermal diffusivity within the droplet phase. Both one-way and two-way coupled calculations were performed to investigate the performance of this model. Validation results indicate the superiority of the finite-conductivity model in low speed parallel flow evaporating sprays. High speed cross flow spray results indicate the effectiveness of the T-blob/T-TAB model and point to the needed improvements in high speed evaporating spray modeling.

Author

*Evaporation; Sprayers; Supersonic Flow; Turbulence Effects; Combustion Physics; Mathematical Models*

**20070014060** NASA Johnson Space Center, Houston, TX, USA

**SUPG Finite Element Simulations of Compressible Flows for Aerothermodynamic Applications**

Kirk, Benjamin S.; March 27, 2007; 59 pp.; In English; 14th Annual Conference on Finite Element Methods, 26-28 Mar. 2007, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): 644423.02.39.10.10.02; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014060>

This viewgraph presentation reviews the Streamline-Upwind Petrov-Galerkin (SUPG) Finite Element Simulation. It covers the background, governing equations, weak formulation, shock capturing, inviscid flux discretization, time discretization, linearization, and implicit solution strategies. It also reviews some applications such as Type IV Shock Interaction, Forward-Facing Cavity and AEDC Sharp Double Cone.

CASI

*Aerothermodynamics; Finite Element Method; Galerkin Method; Linearization; Simulation; Compressible Flow; Upwind Schemes (Mathematics); Computational Fluid Dynamics*

**20070014623** NASA Ames Research Center, Moffett Field, CA, USA

**NASA Ames Arc Jets and Range, Capabilities for Planetary Entry**

Fretter, Ernest F.; 2nd International Planetary Probe Workshop; April 2005, pp. 313-316; In English; See also 20070014606; Copyright; Avail.: CASI: [A01](#), Hardcopy

NASA is pursuing innovative technologies and concepts as part of America's Vision for Space Exploration. The rapidly emerging field of nanotechnology has led to new concepts for multipurpose shields to prevent catastrophic loss of vehicles and crew against the triple threats of aeroheating during atmospheric entry, radiation (Solar and galactic cosmic rays) and Micrometeoroid/Orbital Debris (MMOD) strikes. One proposed concept is the Thermal Radiation Impact Protection System (TRIPS) using carbon nanotubes, hydrogenated carbon nanotubes, and ceramic coatings as a multi-use TPS. The Thermophysics Facilities Branch of the Space Technology Division at NASA Ames Research Center provides testing services for the development and validation of the present and future concepts being developed by NASA and national and International research firms. The Branch operates two key facilities - the Range Complex and the Arc Jets. The Ranges include both the Ames Vertical Gun Range (AVGR) and the Hypervelocity Free Flight (HFF) gas guns best suited for MMOD investigations. Test coupons can be installed in the AVGR or HFF and subjected to particle impacts from glass or metal particles from micron to  $\frac{1}{8}$  inch (6.35-mm) diameters and at velocities from 5 to 8 kilometers per second. The facility can record high-speed data on film and provide damage assessment for analysis by the Principle Investigator or Ames personnel. Damaged articles can be installed in the Arc Jet facility for further testing to quantify the effects of damage on the heat shield s performance upon entry into atmospheric environments.

Author

*Arc Jet Engines; Ballistic Ranges; Aerothermodynamics; Atmospheric Entry*

**20070014636** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium

**Stagnation Point Heat Transfer with Gas Injection Cooling**

Vancrayenest, B.; Tran, M. D.; Fletcher, D. G.; 2nd International Planetary Probe Workshop; April 2005, pp. 69-74; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The present paper deals with an experimental study of the stagnation-point heat transfer to a cooled copper surface with gas injection under subsonic conditions. Test were made with a probe that combined a steady-state water-cooled calorimeter that allows the capability to study convective blockage and to perform heat transfer measurements in presence of gas injection in the stagnation region. The copper probe was pierced by 52 holes, representing 2.4% of the total probe surface. The 1.2 MW high enthalpy plasma wind tunnel was operated at anode powers between 130 and 230 kW and a static pressures from 35 hPa up to 200 hPa. Air, carbon dioxide and argon were injected in the mass flow range 0-0.4 g/s in the boundary layer developed around the 50 mm diameter probe. The measured stagnation-point heat transfer rates are reported and discussed.

Author

*Gas Injection; Heat Transfer; Stagnation Point; Film Cooling; Aerodynamic Heat Transfer; Wind Tunnel Tests*

**20070014770** University of Southern California, Los Angeles, CA, USA

**Evaluation and Analysis of Microscale Flow and Transport During Remediation**

Yortsos, Y. C.; Shing, K.; Mar. 1999; 177 pp.; In English

Contract(s)/Grant(s): EPA-CR-824592

Report No.(s): PB2007-107085; No Copyright; Avail.: CASI: [A09](#), Hardcopy

The design of in-situ remediation is currently based on a description at the macroscopic scale. Phenomena at the pore and pore-network scale are typically lumped in terms of averaged quantities, using empirical or ad hoc expressions. These models cannot address fundamental remediation issues at the pore and pore network scales, including: The emplacement in-situ of the contaminant NAPL, and the displacement patterns; the mass transfer of the contaminant from the NAPL to the groundwater or from the groundwater to a sparging fluid, and of the remedial agents to the NAPL; and possible micro-scale flow instabilities during injection of a remedial fluid. The objective of this work is to obtain a fundamental understanding by conducting theoretical, experimental and computational pore-scale studies. Emphasis is placed at the pore network scale. Use of this information can be incorporated in macroscopic simulators to provide fundamentally correct expressions for the various coefficients or parameters, currently treated empirically. The theoretical findings are compared with findings from experiments in glass micro-models and Hele-Shaw cells.

NTIS

*Displacement; Flow Distribution; Transport Theory*

## INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; 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 and Astrionics*.

**20070013796** Pratt and Whitney Rocketdyne, Canoga Park, CA, USA

### **On-board Optical Spectrometry for Detection of Mixture Ratio and Eroded Materials in Rocket Engine Exhaust Plume**

Barkhoudarian, Sarkis; Kittinger, Scott; [2006]; 7 pp.; In English; JANNAF Conference, 4-8 Dec. 2006, San Diego, CA, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013796>

Optical spectrometry can provide means to characterize rocket engine exhaust plume impurities due to eroded materials, as well as combustion mixture ratio without any interference with plume. Fiberoptic probes and cables were designed, fabricated and installed on Space Shuttle Main Engines (SSME), allowing monitoring of the plume spectra in real time with a Commercial of the Shelf (COTS) fiberoptic spectrometer, located in a test-stand control room. The probes and the cables survived the harsh engine environments for numerous hot-fire tests. When the plume was seeded with a nickel alloy powder, the spectrometer was able to successfully detect all the metallic and OH radical spectra from 300 to 800 nanometers.

Author

*Detection; Exhaust Gases; Fabrication; Rocket Engines; Spectrometers; Optical Measurement; Mixtures; Onboard Equipment*

**20070013846** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **The Solar-B Mission: First Light, Future Plans and Community Participation**

Davis, John M.; [2006]; 1 pp.; In English; 2006 Fall American Geophysical Union Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Solar-B spacecraft was launched from the Uchinoura Space Center into a circular, sun-synchronous, polar orbit by the Japanese Aerospace Exploration Agency in late September 2006. The spacecraft carries three scientific instruments designed to follow the flow of magnetic energy from the photosphere to the corona to improve our understanding of both steady state and transient energy release. This goal will be achieved through coordinated observations of three highly advanced solar telescopes developed cooperatively by teams from Japan, the USA and the UK. The three telescopes are a 0.5m aperture, diffraction limited, solar optical telescope (SOT), an X-ray telescope (XRT) designed for full sun imaging with 1.0 arcsec pixels and an EUV imaging spectrometer (EIS) with an order of magnitude improvement in sensitivity over past instruments. The SOT focal plane contains three instruments, a spectropolarimeter for measuring vector magnetic fields, a broadband filter imager for recording images of the photosphere and chromosphere at the highest resolution the telescope is capable of, and a narrow band filter imager that will record Dopplergrams and vector magnetograms. The XRT has broad temperature coverage and a spatial resolution three times as high as Yohkoh. EIS covers a broad range of transition region and coronal temperatures in two spectral bands. Both XRT and EIS have 2 arcsec spatial resolution (1 arcsec pixels). Instrument first light occurred after five weeks on orbit to allow for out gassing and the opening of the telescopes doors. The initial observation sequences are designed to test the functionality of the different operating modes and for calibration. After this commissioning phase is complete a series of observations are planned to demonstrate the ability of the instruments to meet NASA's mission minimum success criteria. Data is downloaded every orbit to the Norwegian high latitude ground station at Svalbard. The data are transmitted to ISAS where they are reformatted into FITS files and archived as Level 0 data on the ISAS DARTS system. Once the initial observation period is complete, approximately six months after launch, the mission data will be open and freely available to researchers shortly after receipt at the DARTS data archive hosted in Japan and at NASA's Solar Data Analysis Center at the Goddard Space Flight Center. Scientific operations will be conducted from the ISAS facility in Sagami-hara, Japan and the observatory will become available for performing joint operations with both ground and space based instruments and for conducting observing programs proposed by non-team members. This process will be described together with a status report from the initial operation of the observatory, showing examples of the first observations.

Author

*Solar Optical Telescope; Space Missions; Imaging Spectrometers; Japanese Space Program; X Ray Telescopes*



**20070014753** NASA Glenn Research Center, Cleveland, OH, USA

**Micro-Fabricated Solid-State Radiation Detectors for Active Personal Dosimetry**

Wrbanek, John D.; Wrbanek, Susan Y.; Fralick, Gustave C.; Chen, Liang-Yu; February 2007; 24 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 561581.02.08.03.05.05

Report No.(s): NASA/TM-2007-214674; E-15810; Copyright; Avail.: CASI: [A03](#), Hardcopy

Active radiation dosimetry is important to human health and equipment functionality for space applications outside the protective environment of a space station or vehicle. This is especially true for long duration missions to the moon, where the lack of a magnetic field offers no protection from space radiation to those on extravehicular activities. In order to improve functionality, durability and reliability of radiation dosimeters for future NASA lunar missions, single crystal silicon carbide devices and scintillating fiber detectors are currently being investigated for applications in advanced extravehicular systems. For many years, NASA Glenn Research Center has led significant efforts in silicon carbide semiconductor technology research and instrumentation research for sensor applications under extreme conditions. This report summarizes the technical progress and accomplishments toward characterization of radiation-sensing components for the recommendation of their fitness for advanced dosimetry development.

Author

*Dosimeters; Solid State Devices; Fabrication; Extraterrestrial Radiation; Microelectronics*

**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*.

**20070013960** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Cavity Self-Stabilization and Enhancement of Laser Gyroscopes by (Coupled) Optical Resonators**

Smith, David D.; July 07, 2006; 34 pp.; In English; SPIE Photonics West, 22-26 Jan. 2007, San Jose, CA, USA

Contract(s)/Grant(s): CDDF03-17; CDDF04-08; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013960>

We analyze the effect of a highly dispersive element placed inside a modulated optical cavity on the frequency and amplitude of the modulation to determine the conditions for cavity self-stabilization and enhanced gyroscopic sensitivity. Hence, we model cavity rotation or instability by an arbitrary AM/FM modulation, and the dispersive element as a phase and amplitude filter. We find that anomalous dispersion may be used to self-stabilize a laser cavity, provided the magnitude of the group index of refraction is smaller than the phase index of refraction in the cavity. The optimal stabilization is found to occur when the group index is zero. Group indices with magnitudes larger than the phase index (both normal and anomalous dispersion) are found to enhance the sensitivity of a laser gyroscope to rotation. Furthermore, our results indicate that atomic media, even coherent superpositions in multilevel atoms, are not useful for these applications, because the amplitude and phase filters work against one another, i.e., decreasing the modulation frequency increases its amplitude and vice versa, with one exception: negative group indices whose magnitudes are larger than the phase index result in negative, but enhanced, beat frequencies. On the other hand, for optical resonators the dispersion reversal associated with critical coupling enables the amplitude and phase filters to work together under a greater variety of circumstances than for atomic media. We find that for single over-coupled resonators, or in the case of under-coupled coupled-resonator-induced absorption, the absorption and normal dispersion on-resonance increase the contrast and frequency of the beat-note, respectively, resulting in a substantial enhancement of the gyroscopic response. Moreover, for cavity self-stabilization, we propose the use of a variety of coupled-resonator induced transparency that is accompanied by anomalous dispersion.

Author

*Cavities; Laser Gyroscopes; Optical Resonators; Stabilization*

**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*.

**20070013885** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Performance of a Low-Power Cylindrical Hall Thruster**

Polzin, Kurt A.; Markusic, Thomas E.; Stanojev, Boris J.; Dehoyos, Amado; Raitses, Yevgeny; Smirnov, Artem; Fisch, Nathaniel J.; [2007]; 8 pp.; In English

Contract(s)/Grant(s): NAS8-05791; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013885>

Recent mission studies have shown that a Hall thruster which operates at relatively constant thrust efficiency (45-55%) over a broad power range (300W - 3kW) is enabling for deep space science missions when compared with state-of-the-art ion thrusters. While conventional (annular) Hall thrusters can operate at high thrust efficiency at kW power levels, it is difficult to construct one that operates over a broad power envelope down to 0 (100 W) while maintaining relatively high efficiency. In this note we report the measured performance (I(sub sp), thrust and efficiency) of a cylindrical Hall thruster operating at 0 (100 W) input power.

Derived from text

*Cylindrical Bodies; Hall Thrusters; Power Efficiency; Thrust Measurement*

**20070014595** Lawrence Livermore National Lab., Livermore, CA USA

**Simple HCCI Engine Model for Control**

Killingsworth, N.; Aceves, S.; Flowers, D.; Krstic, K.; Jun. 30, 2006; 8 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896610; UCRL-CONF-222524; No Copyright; Avail.: National Technical Information Service (NTIS)

The homogeneous charge compression ignition (HCCI) engine is an attractive technology because of its high efficiency and low emissions. However, HCCI lacks a direct combustion trigger making control of combustion timing challenging, especially during transients. To aid in HCCI engine control we present a simple model of the HCCI combustion process valid over a range of intake pressures, intake temperatures, equivalence ratios, and engine speeds. The model provides an estimate of the combustion timing on a cycle-by-cycle basis. An ignition threshold, which is a function of the in-cylinder motored temperature and pressure is used to predict start of combustion. This model allows the synthesis of nonlinear control laws, which can be utilized for control of an HCCI engine during transients.

NTIS

*Combustion Control; Diesel Engines; Engine Control; Models*

**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 42 through 48*.

**20070013856** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Interannual and Seasonal Variability of the Tropopause Layer over the Tropical Americas**

Pittman, Jasna V.; Miller, Timothy L.; Robertson, Franklin R.; Dec. 15, 2006; 1 pp.; In English; 2006 American Geophysical Union Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

This study explores the thermodynamic and convective characteristics of the Tropical Tropopause Layer (TTL) over the Tropical Americas using multi-platform measurements collected during the last five years. This region is chosen for the following reasons: (i) it becomes the second most dominant source of air to the TTL, (ii) it exhibits the largest seasonal increase in percent contribution to stratospheric moisture, (iii) it has the warmest tropical tropopause temperatures, and (iv) it can be influenced by midlatitude and subtropical air masses that are transported equatorward by the upper-level circulation associated with the North American Monsoon. We examine the interannual and seasonal variability of water vapor, ozone, and temperature using aircraft data collected aboard the WB-57, satellite data from the Aura-MLS and Aqua-AIRS instruments,

and GPS radio occultation measurements from the CHAMP satellite. We also examine the vertical extent and frequency of convection in the region using data from TRMM. In addition, we perform seasonal trajectory calculations to elucidate the origin and fate of air masses found in our region of interest.

Author

*Annual Variations; Tropical Regions; Tropopause; United States*

**20070013864** Geological Survey, Reston, VA USA

**Land-Cover Trends in the Sierra Nevada Ecoregion, 1973-2000**

Raumann, C. G.; Soulard, C. E.; January 2007; 34 pp.; In English

Report No.(s): PB2007-107131; USGS-SIR-2007-5011; No Copyright; Avail.: National Technical Information Service (NTIS)

The U.S. Geological Survey has developed and is implementing the Land Cover Trends project to estimate and describe the temporal and spatial distribution and variability of contemporary land-use and land-cover change in the USA. As part of the Land Cover Trends project, the purpose of this study was to assess land-use/land-cover change in the Sierra Nevada ecoregion for the period 1973 to 2000 using a probability sampling technique and satellite imagery. We randomly selected 36 100-km<sup>2</sup> sample blocks to derive thematic images of land-use/land-cover for five dates of Landsat imagery (1973, 1980, 1986, 1992, 2000). We visually interpreted as many as 11 land-use/land-cover classes using a 60-meter minimum mapping unit from the five dates of imagery yielding four periods for analysis. Change-detection results from post-classification comparison of our mapped data showed that landscape disturbance from fire was the dominant change from 1973-2000. The second most-common change was forest disturbance resulting from harvest of timber resources by way of clear-cutting. The rates of forest regeneration from temporary fire and harvest disturbances coincided with the rates of disturbance from the previous period. Relatively minor landscape changes were caused by new development and reservoir drawdown. Multiple linear regression analysis suggests that land ownership and the proportion of forest and developed cover types were significant determinants of the likelihood of direct human-induced change occurring in sampling units. Driving forces of change include land ownership, land management such as fire suppression policy, and demand for natural resources.

NTIS

*Land Use; Sierra Nevada Mountains (CA); Vegetation; Land Management*

## 43

### EARTH RESOURCES AND REMOTE SENSING

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

**20070013784** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Sensor Management for Applied Research Technologies (SMART)-On Demand Modeling (ODM) Project**

Goodman, M.; Blakeslee, R.; Hood, R.; Jedlovec, G.; Botts, M.; Li, X.; [2006]; 1 pp.; In English; 2006 Fall AGU Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

NASA requires timely on-demand data and analysis capabilities to enable practical benefits of Earth science observations. However, a significant challenge exists in accessing and integrating data from multiple sensors or platforms to address Earth science problems because of the large data volumes, varying sensor scan characteristics, unique orbital coverage, and the steep learning curve associated with each sensor and data type. The development of sensor web capabilities to autonomously process these data streams (whether real-time or archived) provides an opportunity to overcome these obstacles and facilitate the integration and synthesis of Earth science data and weather model output. A three year project, entitled Sensor Management for Applied Research Technologies (SMART) - On Demand Modeling (ODM), will develop and demonstrate the readiness of Open Geospatial Consortium (OGC) Sensor Web Enablement (SWE) capabilities that integrate both Earth observations and forecast model output into new data acquisition and assimilation strategies. The advancement of SWE-enabled systems (i.e., use of SensorML, sensor planning services - SPS, sensor observation services - SOS, sensor alert services - SAS and common observation model protocols) will have practical and efficient uses in the Earth science community for enhanced data set generation, real-time data assimilation with operational applications, and for autonomous sensor tasking for unique data collection.

Author

*Mathematical Models; Technology Utilization; Earth Sciences; Sensors; Data Processing*

**20070013785** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Need for High Spatial Resolution Multispectral Thermal Remote Sensing Data In Urban Heat Island Research**  
Quattrochi, Dale A.; Luvall, Jeffrey C.; December 14, 2006; 1 pp.; In English; 2006 AGU Annual Meeting, 11-14 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Although the study of the Urban Heat Island (UHI) effect dates back to the early 1800's when Luke Howard discovered London's heat island, it has only been with the advent of thermal remote sensing systems that the extent, characteristics, and impacts of the UHI have become to be understood. Analysis of the UHI effect is important because above all, this phenomenon can directly influence the health and welfare of urban residents. For example, in 1995, over 700 people died in Chicago due to heat-related causes. UHI's are characterized by increased temperature in comparison to rural areas and mortality rates during a heat wave increase exponentially with the maximum temperature, an effect that is exacerbated by the UHI. Aside from the direct impacts of the UHI on temperature, UHI's can produce secondary effects on local meteorology, including altering local wind patterns, increased development of clouds and fog, and increasing rates of precipitation either over, or downwind, of cities. Because of the extreme heterogeneity of the urban surface, in combination with the sprawl associated with urban growth, thermal infrared (TIR) remote sensing data have become of significant importance in understanding how land cover and land use characteristics affect the development and intensification of the UHI. TIR satellite data have been used extensively to analyze the surface temperature regimes of cities to help observe and measure the impacts of surface temperatures across the urban landscape. However, the spatial scales at which satellite TIR data are collected are for the most part, coarse, with the finest readily available TIR data collected by the Landsat ETM+ sensor at 60m spatial resolution. For many years, we have collected high spatial resolution (10m) data using an airborne multispectral TIR sensor over a number of cities across the USA. These high resolution data have been used to develop an understanding of how discrete surfaces across the urban environment (e.g., rooftops, pavements) interact from a surface-lower atmosphere energy flux perspective, to force the development of the UHI. Moreover, the airborne TIR sensor we used in our UHI studies was a multispectral sensor that had six channels in the 8-12 $\mu$ m range. The advantages of collecting multispectral TIR data became readily evident as a valuable tool for better calculation of unique surface thermal energy responses for urban materials over the 8-12 micrometer region, and also for getting a better handle on surface emissivity characteristics for these discrete surfaces. In this presentation, we will provide evidence on the virtues of how high spatial resolution multispectral TIR data can provide for better analysis of the UHI that cannot now be attained via TIR data obtained from satellites. Furthermore, we wish to provide compelling evidence on why future TIR satellite sensors should collect data at fine spatial resolutions (e.g. less than or equal to 30m) to better allow for measurement of surface thermal energy fluxes from discrete urban surfaces, and to better understand how surface fluxes from different urban materials in cities around the world in different climatic regimes, affect development of the UHI characteristics.

Author

*Cities; Heat Islands; Remote Sensing; Spatial Resolution; Urban Research*

**20070013994** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Methods for Characterizing Fine Particulate Matter Using Satellite Remote-Sensing Data and Ground Observations: Potential Use for Environmental Public Health Surveillance**

Al-Hamdan, Mohammad Z.; Crosson, William L.; Limaye, Ashutosh S.; Rickman, Douglas L.; Quattrochi, Dale A.; Estes, Maurice G.; Qualters, Judith R.; Niskar, Amanda S.; Sinclair, Amber H.; Tolsma, Dennis D.; Adeniyi, Kafayat A.; [2007]; 34 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

This study describes and demonstrates different techniques for surfacing daily environmental / hazards data of particulate matter with aerodynamic diameter less than or equal to 2.5 micrometers (PM<sub>2.5</sub>) for the purpose of integrating respiratory health and environmental data for the Centers for Disease Control and Prevention (CDC's) pilot study of Health and Environment Linked for Information Exchange (HELIX)-Atlanta. It described a methodology for estimating ground-level continuous PM<sub>2.5</sub> concentrations using B-Spline and inverse distance weighting (IDW) surfacing techniques and leveraging National Aeronautics and Space Administration (NASA) Moderate Resolution Imaging Spectrometer (MODIS) data to complement The Environmental Protection Agency (EPA) ground observation data. The study used measurements of ambient PM<sub>2.5</sub> from the EPA database for the year 2003 as well as PM<sub>2.5</sub> estimates derived from NASA's satellite data. Hazard data have been processed to derive the surrogate exposure PM<sub>2.5</sub> estimates. The paper has shown that merging MODIS remote sensing data with surface observations of PM<sub>2.5</sub> not only provides a more complete daily representation of PM<sub>2.5</sub> than either data set alone would allow, but it also reduces the errors in the PM<sub>2.5</sub> estimated surfaces. The results of this paper have shown that the daily IDW PM<sub>2.5</sub> surfaces had smaller errors, with respect to observations, than those of the B-Spline surfaces in the year studied. However the IDW mean annual composite surface had more numerical artifacts, which could be due to the interpolating nature of the IDW that assumes that the maxima and minima can occur only at the observation points. Finally,

the methods discussed in this paper improve temporal and spatial resolutions and establish a foundation for environmental public health linkage and association studies for which determining the concentrations of an environmental hazard such as PM2.5 with good accuracy levels is critical.

Author

*Particulates; Public Health; Remote Sensing; Surveillance; Environmental Monitoring; Matter (Physics); Characterization; Data Acquisition*

**20070014089** NASA Stennis Space Center, Stennis Space Center, MS, USA

**Earth Observations to Assess Impact of Hurricane Katrina on John C. Stennis Space Center**

Graham, William D.; Ross, Kenton W.; [2007]; 1 pp.; In English; JACIE Civil Commercial Imagery Evaluation Workshop, 20-22 Mar. 2007, Fairfax, VA, USA

Contract(s)/Grant(s): NNS04AB54T

Report No.(s): SSTI-2220-0103; No Copyright; Avail.: Other Sources; Abstract Only

The peril from hurricanes to Space Operations Centers is real and is forecast to continue; Katrina, Rita, and Wilma of 2005 and Charley, Frances, Ivan, and Jeanne of 2004 are sufficient motivation for NASA to develop a multi-Center plan for preparedness and response. As was demonstrated at SSC (Stennis Space Center) in response to Hurricane Katrina, NASA Centers are efficiently activated as local command centers, playing host to Federal and State agencies and first responders to coordinate and provide evacuation, relocation, response, and recovery activities. Remote sensing decision support provides critical insight for managing NASA infrastructure and for assisting Center decision makers. Managers require geospatial information to manage the federal city. Immediately following Katrina, SSC's power and network connections were disabled, hardware was inoperative, technical staff was displaced and/or out of contact, and graphical decision support tools were non-existent or less than fully effective. Despite this circumstance, SSC EOC (Emergency Operations Center) implemented response operations to assess damage and to activate recovery plans. To assist Center Managers, the NASA ASP (Applied Sciences Program) made its archive of high-resolution data over the site available. In the weeks and months after the immediate crisis, NASA supplemented this data with high-resolution, post-Katrina imagery over SSC and much of the affected coastal areas. Much of the high-resolution imagery was made available through the Department of Defense Clear View contract and was distributed through U.S. Geological Survey Center for Earth Resources Observation and Science 'Hurricane Katrina Disaster Response' Web site. By integrating multiple image data types with other information sources, ASP applied an all-source solutions approach to develop decision support tools that enabled managers to respond to critical issues, such as expedient access to infrastructure and deployment of resources, provision of temporary shelter, logistical control of critical supplies, and the mobilization and coordination of assets from ground crews to aircraft/airspace management. Furthermore, ASP developed information products that illustrate risks to SSC's infrastructure from surge, inundation, and flood. Current plans include developing wind-risk prototype products for refinement and adoption into EOC plans.

Author

*Disasters; Earth Observations (From Space); Hurricanes; Imagery; Remote Sensing; Image Analysis*

**20070014090** NASA Stennis Space Center, Stennis Space Center, MS, USA

**All Source Solution Decision Support Products Created for Stennis Space Center in Response to Hurricane Katrina**

Ross, Kenton W.; Graham, William D.; [2007]; 1 pp.; In English

Contract(s)/Grant(s): NNS04AB54T

Report No.(s): SSTI-2220-0102; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014090>

In the aftermath of Hurricane Katrina and in response to the needs of SSC (Stennis Space Center), NASA required the generation of decision support products with a broad range of geospatial inputs. Applying a systems engineering approach, the NASA ARTPO (Applied Research and Technology Project Office) at SSC evaluated the Center's requirements and source data quality. ARTPO identified data and information products that had the potential to meet decision-making requirements; included were remotely sensed data ranging from high-spatial-resolution aerial images through high-temporal-resolution MODIS (Moderate Resolution Imaging Spectroradiometer) products. Geospatial products, such as FEMA's (Federal Emergency Management Agency's) Advisory Base Flood Elevations, were also relevant. Where possible, ARTPO applied SSC calibration/validation expertise to both clarify the quality of various data source options and to validate that the inputs that were finally chosen met SSC requirements. ARTPO integrated various information sources into multiple decision support products, including two maps: Hurricane Katrina Inundation Effects at Stennis Space Center (highlighting surge risk posture)



and Vegetation Change In and Around Stennis Space Center: Katrina and Beyond (highlighting fire risk posture).

Author

*Emergencies; Hurricanes; Remote Sensing; Decision Support Systems; Management Planning; Decision Making; Imaging Techniques*

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### 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*.

**20070014729** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Encouraging PV Adoption in New Market-Rate Residential Construction: A Critical Review of Program Experiences to Date**

Barbose, G.; Wiser, R.; Bolinger, M.; Apr. 24, 2006; 6 pp.; In English

Contract(s)/Grant(s): DE-AC02-05CH11231

Report No.(s): DE2007-889620; LBNL-59744; No Copyright; Avail.: Department of Energy Information Bridge

In this paper, we review experiences with programs to support the deployment of photovoltaics (PV) in new, market-rate homes, drawing upon interviews with program managers around the country, project data, and publicly-available documentation on program design, impacts, and experiences. We focus on state clean energy funds, which have been established in 14 U.S. states to build markets for clean energy resources, as well as a select number of other state or local organizations whose activities are particularly noteworthy. We describe the types of programs implemented and their impacts to date, and discuss key issues and lessons learned for initiatives aimed at growing the new home market for PV.

NTIS

*Buildings; Clean Energy; Photovoltaic Conversion*

**20070014785** North Carolina State Univ., Raleigh, NC USA, Siemens Power Generation, Inc., Orlando, FL, USA

**Next Generation Engineered Materials for Ultra Supercritical Steam Turbines. (Final Report, September 2003-May 2006)**

Arrell, D.; Jun. 2006; 87 pp.; In English

Contract(s)/Grant(s): DE-FC26-04NT42232

Report No.(s): DE2006-896682; No Copyright; Avail.: National Technical Information Service (NTIS)

To reduce the effect of global warming on our climate, the levels of CO<sub>2</sub> emissions should be reduced. One way to do this is to increase the efficiency of electricity production from fossil fuels. This will in turn reduce the amount of CO<sub>2</sub> emissions for a given power output. Using US practice for efficiency calculations, then a move from a typical US plant running at 37% efficiency to a 760 deg C/38.5 MPa (1400DGF/5580 psi) plant running at 48% efficiency would reduce CO<sub>2</sub> emissions by 170kg/MW.hr or 25%. This report presents a literature review and roadmap for the materials development required to produce a 760 deg C (1400DGF)/38.5MPa (5580 psi) steam turbine without use of cooling steam to reduce the material temperature. The report reviews the materials solutions available for operation in components exposed to temperatures in the range of 600 to 760 C, i.e. above the current range of operating conditions for today's turbines. A roadmap of the timescale and approximate cost for carrying out the required development is also included. The nano-structured austenitic alloy CF8C+ was investigated during the program, and the mechanical behavior of this alloy is presented and discussed as an illustration of the potential benefits available from nano-control of the material structure.

NTIS

*Austenite; Energy Conservation; Steam Turbines; Pollution Control*

**20070014788** National Renewable Energy Lab., Golden, CO USA, Abilene Christian Univ., TX, USA

**New Market Paradigm for Zero-Energy Homes: The Comparative San Diego Case Study. Volume 1 of 2**

Farhar, B. C.; Coburn, T. C.; Dec. 2006; 413 pp.; In English

Report No.(s): DE2006-896720; NREL/TP-550-38304-01; No Copyright; Avail.: National Technical Information Service (NTIS)

This study suggests a conceptually fresh alternative paradigm for the building and marketing of zero-energy homes

(ZEHs) based on experience which will help builders create sustainable communities for our well-being and that of future generations.

NTIS

*Energy Conservation; Marketing; Structural Design; Architecture*

## 45

### ENVIRONMENT POLLUTION

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

**20070013753** Agency for Toxic Substances and Disease Registry, Atlanta, GA USA

**Public Health Assessment for East Kelly Air Force Base, San Antonio, Bexar County, Texas, February 27, 2007. EPA**

**Facility ID: TX2571724333**

Feb. 27, 2007; 103 pp.; In English

Report No.(s): PB2007-106614; No Copyright; Avail.: National Technical Information Service (NTIS)

The late Congressman Frank Tejeda (1945-1997) initially petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate the potential public health impact of contaminants released from Kelly Air Force Base. This evaluation request subsequently extended to East Kelly as well. Community members in the East Kelly area are concerned that they may have been exposed to contaminants from the Kelly AFB east annex via stormwater runoff, shallow groundwater, blowing dust, and soil gas. Community members further believe these contaminants could cause various adverse health effects, including cancer, immune system disorders, nervous system disorders, birth defects, liver problems, skin problems, respiratory illnesses, muscular problems, nosebleeds, and headaches. After reviewing available environmental and health outcome data, ATSDR has determined that the levels of contaminants detected at off-site locations associated with East Kelly Air Force Base are not likely to cause adverse health effects. The agency concludes that the contaminants at East Kelly pose no apparent public health hazard. Data were inconclusive regarding on-site indoor air exposures for other than industrial and limited commercial uses. ATSDR categorizes on-site exposure for uses other than industrial and limited commercial as an indeterminate public health hazard. Because of community concerns, ATSDR evaluated contaminated surface soil from area S009 within the East Kelly site. The evaluation sought to determine whether chemicals at levels of health concern could migrate off site via stormwater runoff or wind-blown dust. Soil gas samples were evaluated to determine whether residents near East Kelly are currently exposed to volatile organic compounds migrating into their homes from the contaminated shallow groundwater. Data from shallow-aquifer private wells were reviewed to determine whether residents near East Kelly are exposed to contaminated groundwater.

NTIS

*Assessments; Contaminants; Public Health; Risk; Texas; Toxic Diseases*

**20070013754** Abt Associates, Inc., Bethesda, MD, USA

**Ozone Health Risk Assessment for Selected Urban Areas**

Post, E.; Maier, A.; Mahoney, H.; Jan. 2007; 460 pp.; In English

Contract(s)/Grant(s): 68-D-03-002

Report No.(s): PB2007-106578; EPA-452/R-07-001; No Copyright; Avail.: National Technical Information Service (NTIS)

The U.S. Environmental Protection Agency (EPA) is presently conducting a review of the national ambient air quality standards (NAAQS) for ozone (O<sub>3</sub>). Sections 108 and 109 of the Clean Air Act (Act) govern the establishment and periodic review of the NAAQS. These standards are established for pollutants that may reasonably be anticipated to endanger public health and welfare, and whose presence in the ambient air results from numerous or diverse mobile or stationary sources. The NAAQS are to be based on air quality criteria, which are to accurately reflect the latest scientific knowledge useful in indicating the kind and extent of identifiable effects on public health or welfare that may be expected from the presence of the pollutant in ambient air. The EPA Administrator is to promulgate and periodically review, at five-year intervals, primary (health-based) and secondary (welfare-based) NAAQS for such pollutants. Based on periodic reviews of the air quality criteria and standards, the Administrator is to make revisions in the criteria and standards, and promulgate any new standards, as may be appropriate. The Act also requires that an independent scientific review committee advise the Administrator as part of this NAAQS review process, a function performed by the Clean Air Scientific Advisory Committee (CASAC).

NTIS

*Air Quality; Ambience; Assessments; Cities; Health; Ozone; Risk*

**20070013755** Office of Air Quality Planning and Standards, Research Triangle Park, NC USA

**Ozone Population Exposure Analysis for Selected Urban Areas**

Jan. 2007; 301 pp.; In English

Report No.(s): PB2007-106577; EPA-452/R-07-004; No Copyright; Avail.: National Technical Information Service (NTIS)

This report documents the methodology and input data used in the inhalation exposure assessment for ozone conducted in support of the current review of the ozone NAAQS. Specifically, this report includes the following: Summary of the overall inhalation exposure assessment methodology; Description of the inhalation exposure model used in this assessment; Description of the input data used for the 12 selected urban areas; Assessment of the quality and limitations of the input data for supporting the goals of the ozone NAAQS exposure analysis; and Sensitivity analyses.

NTIS

*Air Quality; Ambience; Cities; Exposure; Ozone; Populations*

**20070013808** Environmental Protection Agency, Research Triangle Park, NC, USA

**Indoor Air-Assessment Indoor Biological Pollutants**

Jan. 1992; 112 pp.; In English

Report No.(s): PB2007-106167; EPA 600/8-91/202; No Copyright; Avail.: CASI: [A06](#), Hardcopy

Biological aerosols have been recognized as indoor hazards for several hundred years. Pasteur demonstrated that infectious diseases are transmitted through indoor air. Dust has been a recognized allergen since the mid-19th century. Recently, however, the role of indoor air in transmission of infectious disease has been de-emphasized, and the problems associated with other kinds of indoor bioaerosols have received only minimal public health attention. This is in spite of the fact that we spend an average of 22 hours/day indoors. Influenza causes 10,000 deaths per year. The house dust mite is probably the single most important cause of asthma among children and young adults. Indoor allergens are thought to be responsible for as much as 50% of the incidence of acute asthma in adults under 50 years old. Microbial toxins are among the most toxic substances known to man with effects that include acute toxicity symptoms, birth defects, cancer, and in some cases, death. The concentrations and health effects of these toxins are completely unknown for the vast majority of indoor environments. Volatile organic compounds are produced by all microorganisms and accumulate in confined spaces, causing odors and possibly unknown health effects. The nature of these substances, their health effects, and concentrations in indoor environments is unknown.

NTIS

*Contaminants; Indoor Air Pollution; Biological Hazards; Aerosols*

**20070013809** Environmental Protection Agency, Washington, DC, USA

**Presentation of Risk Assessments of Carcinogens. Appendix B: List of Case Studies**

Aug. 1989; 437 pp.; In English

Report No.(s): PB2007-106172; EPA 600/9-90/031B; No Copyright; Avail.: CASI: [A19](#), Hardcopy

Contents: Introduction; Life of Case Studies and Ordering Information; Excerpts from the Case Studies Illustrating the Attributes: General Attributes; Hazard Identification; Dose-Response Evaluation; Exposure Assessment; and Risk Characterization.

NTIS

*Air Pollution; Carcinogens; Risk*

**20070013810** Environmental Protection Agency, Washington, DC, USA

**Scientific Seminar on Automotive Pollutants. Held at Thomas Jefferson Memorial Auditorium, Washington, DC. on February 10-12, 1975**

Feb. 1975; 799 pp.; In English

Report No.(s): PB2007-106178; EPA 600/9-75/003; No Copyright; Avail.: CASI: [A99](#), Hardcopy

On February 10-12, 1975 the Scientific Seminar on Automotive Pollutants was held in the Thomas Jefferson Memorial Auditorium at the U.S. Department of Agriculture in Washington, D.C. The purpose of the Seminar was to continue to assemble information on the health effects and atmospheric chemistry of air pollutants, primarily nitrogen oxide (NO<sub>x</sub>), but also carbon monoxide (CO) and hydrocarbon (HC), from automobiles, by offering the scientific community and other interested persons this forum as an opportunity to present the most recent research knowledge.

NTIS

*Air Pollution; Automobiles; Contaminants; Exhaust Gases*

**20070013814** Environmental Protection Agency, Research Triangle Park, NC, USA

**Industrial Environmental Research Laboratory, 1979 Research Review**

Mar. 1980; 59 pp.; In English

Report No.(s): PB2007-106181; EPA 600/9-80/025; No Copyright; Avail.: CASI: A04, Hardcopy

Although mobile sources like cars and trucks contribute to our Nation's pollution problems, much of our air, land, and water pollution come from stationary sources, such as power plants, oil refineries, and industries that manufacture steel, textiles, and pesticides. Today there are more than 20,000 major stationary sources in the USA and hundreds of thousands of lesser ones, including home and commercial furnaces. These sources are a primary cause of the environmental problems identified by the U.S. Environmental Protection Agency (EPA) as having 'potential for widespread adverse effects on human health and welfare'. The combustion of fossil fuels (coal, oil, and natural gas) causes a large part of the pollution from stationary sources. As supplies of oil and natural gas dwindle, more power plants and industries will convert to coal, a 'dirtier' fuel that emits significantly more of most major pollutants. As a result, pollution from stationary sources will increase in the years ahead unless we do something about it now.

NTIS

*Air Pollution; Environment Effects; Environmental Laboratories; Pollution Control*

**20070013832** State Univ. of New York, Albany, NY, USA

**Atmospheric Peroxy Radicals and Peroxides. Report for April 1998 to March 2005**

Weinstein-Lloyd, J.; January 2005; 5 pp.; In English

Contract(s)/Grant(s): DE-FG02-98ER62586

Report No.(s): DE2006-895331; No Copyright; Avail.: Department of Energy Information Bridge

This research project employed a combination of laboratory, field and modeling activities to explore the fate of reactive species in the atmosphere. Our work focused particularly on the behavior of hydroperoxides and their precursors, hydroperoxy radicals. Initially, we pursued the study of these species to elucidate the role they play in the formation of photochemical smog. In recent years, we have extended our studies to the role of these oxidants in forming aerosol particles, due the potential of the latter to influence climate by changing the radiative properties of the atmosphere.

NTIS

*Peroxides; Radicals; Research and Development*

**20070013834** Cincinnati Univ., OH, USA

**Simultaneous Removal of NO(sub x) and Mercury in Low Temperature Selective Catalytic and Adsorptive Reactor. Final Scientific Report for September 1, 2004 to February 2004**

Pinto, N. G.; Smitiotis, P. G.; Aug. 2006; 34 pp.; In English

Contract(s)/Grant(s): DE-FG26-04NT42180

Report No.(s): DE2006-895484; No Copyright; Avail.: National Technical Information Service (NTIS)

The results of a 18-month investigation to advance the development of a novel Low Temperature Selective Catalytic and Adsorptive Reactor (LTSCAR), for the simultaneous removal of NO<sub>x</sub> and mercury (elemental and oxidized) from flue gases in a single unit operation located downstream of the particulate collectors, are reported. In the proposed LTSCAR, NO<sub>x</sub> removal is in a traditional SCR mode but at low temperature, and, uniquely, using carbon monoxide as a reductant. The concomitant capture of mercury in the unit is achieved through the incorporation of a novel chelating adsorbent. As conceptualized, the LTSCAR will be located downstream of the particulate collectors (flue gas temperature 140-160oC) and will be similar in structure to a conventional SCR. That is, it will have 3-4 beds that are loaded with catalyst and adsorbent allowing staged replacement of catalyst and adsorbent as required.

NTIS

*Adsorptivity; Air Pollution; Low Temperature; Nitrous Oxides; Pollution Control*

**20070013836** Research Triangle Inst., Research Triangle Park, NC USA

**Carbon Dioxide Capture from Flue Gas Using Dry, Regenerable Sorbents. Quarterly Technical Progress Report, January 1, 2006 to March 31, 2006**

Green, D. A.; Nelson, T. O.; Turk, B. S.; Box, P. D.; Gupta, R. P.; Apr. 2006; 12 pp.; In English

Contract(s)/Grant(s): DE-FC26-00NT40923

Report No.(s): DE2006-895490; No Copyright; Avail.: Department of Energy Information Bridge

This report describes research conducted between January 1, 2006, and March 31, 2006, on the use of dry regenerable

sorbents for removal of carbon dioxide (CO<sub>2</sub>) from coal combustion flue gas. An integrated system composed of a downflow co-current contact absorber and two hollow screw conveyors (regenerator and cooler) was assembled, instrumented, debugged, and calibrated. A new batch of supported sorbent containing 15% sodium carbonate was prepared and subjected to surface area and compact bulk density determination.

NTIS

*Carbon Dioxide; Drying; Flue Gases; Sorbents*

**20070013837** Western Research Inst., Laramie, WY, USA

**Evaluation of Biomass and Coal Slurries as Fuel-Lean Reburn Fuels**

Nov. 2006; 20 pp.; In English

Report No.(s): DE2006-895538; WRI-06-R024; No Copyright; Avail.: National Technical Information Service (NTIS)

The overall goal of the project was to determine the NO<sub>x</sub> reduction potential of various biomass and coal reburn fuels, and to identify the optimum conditions for NO<sub>x</sub> control. Specific objectives were to inject biomass, biosolids, coal, biomass/coal, and biosolids/coal slurries into the upper furnace of CTF and determine the resulting NO<sub>x</sub> reductions and CO emissions, to identify optimum injection rates and injection locations for these reburn fuels, and to install a reaction zone stabilizer device in CTF and determine its effectiveness in reducing CO and further reducing NO<sub>x</sub>.

NTIS

*Air Pollution; Biomass; Coal; Energy Policy; Fuels; Pollution Control; Slurries*

**20070013839** Texas Univ., Austin, TX, USA

**CO(sub 2) Capture by Absorption with Potassium Carbonate Third Quarterly Report 2006. Reporting Period July 1, 2006 to September 30, 2006**

Oct. 25, 2006; 55 pp.; In English

Contract(s)/Grant(s): DE-FC26-02NT41440

Report No.(s): DE2006-895539; No Copyright; Avail.: National Technical Information Service (NTIS)

The objective of this work is to improve the process for CO<sub>2</sub> capture by alkanolamine absorption/stripping by developing an alternative solvent, aqueous K<sub>2</sub>CO<sub>3</sub> promoted by piperazine. Ethylenediamine was detected in a degraded solution of MEA/PZ solution, suggesting that piperazine is subject to oxidation. Stripper modeling has demonstrated that vacuum strippers will be more energy efficient if constructed short and fat rather than tall and skinny. The matrix stripper has been identified as a configuration that will significantly reduce energy use. Extensive measurements of CO<sub>2</sub> solubility in 7 m MEA at 40 and 60°C have confirmed the work by Jou and Mather. Corrosion of carbon steel without inhibitors increases from 19 to 181 mpy in lean solutions of 6.2 m MEA/PZ as piperazine increases from 0 to 3.1 m.

NTIS

*Carbon Dioxide; Carbonates; Potassium*

**20070013852** Office of Air Quality Planning and Standards, Research Triangle Park, NC USA

**Review of the National Ambient Air Quality Standards for Ozone: Policy Assessment of Scientific and Technical Information. Appendices to OAQPS Staff Paper**

Jan. 2007; 251 pp.; In English

Report No.(s): PB2007-106580; EPA-452/R-07-003; No Copyright; Avail.: National Technical Information Service (NTIS)

The purpose of this document is to evaluate the policy implications of the key scientific and technical information contained in a related EPA document, Air Quality Criteria for Ozone and Related Photochemical Oxidants, required under sections 108 and 109 of the Clean Air Act (CAA) for use in the periodic review of the national ambient air quality standards (NAAQS) for ozone.

NTIS

*Air Quality; Ozone; Environmental Monitoring; Pollution Monitoring; Air Pollution*

**20070013853** Brookhaven National Lab., Upton, NY USA

**Microbial Transformations of Tru and Mixed Wastes: Actinide Speciation and Waste Volume Reduction. Final Report**

Francis, A. J.; Dodge, C. J.; Nov. 01, 2006; 11 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-896456; BNL-773000-2006; No Copyright; Avail.: Department of Energy Information Bridge

The overall goals of this research project are to determine the mechanism of microbial dissolution and stabilization of



actinides in Department of Energy's (DOE) TRU wastes, contaminated sludges, soils, and sediments. This includes (1) investigations on the fundamental aspects of microbially catalyzed radionuclide and metal transformations (oxidation/reduction reactions, dissolution, precipitation, chelation); (2) understanding of the microbiological processes that control speciation and alter the chemical forms of complex inorganic/organic contaminant mixtures; and (3) development of new and improved microbially catalyzed processes resulting in immobilization of metals and radionuclides in the waste with concomitant waste volume reduction.

NTIS

*Actinide Series; Microorganisms; Waste Disposal; Transuranium Elements; Mixing*

**20070013860** Environmental Protection Agency, Washington, DC, USA

**Wastes from the Combustion of Fossil Fuels. Volume 2: Methods, Findings, and Recommendations**

Mar. 1999; 232 pp.; In English

Report No.(s): PB2007-106998; EPA/530/R-99/010; No Copyright; Avail.: National Technical Information Service (NTIS)

This report was prepared in response to the requirements of Section 8002(n) of RCRA, which directs EPA to provide a detailed and comprehensive study on the sources and quantities of certain large-volume wastes generated primarily from the combustion of coal or other fossil fuels, potential human health and environmental impacts posed by the management of these wastes, alternatives to current practices, and costs of such alternatives. In keeping with its court-ordered schedule and pursuant to the requirements of Section 3001(b)(3)(A)(i) and Section 8002(n) of RCRA, the EPA has prepared this report on remaining FFC wastes. In addition to complying with the Congressional mandate, this report will serve to establish a factual basis for EPA decision-making regarding the appropriate regulatory status, under RCRA, of remaining FFC wastes. The report addresses the following eight study factors required by Section 8002(n) of RCRA for FFC wastes: the source and volumes of such materials generated per year; present disposal practices; potential danger, if any, to human health and the environment from the disposal of such materials; documented cases in which danger to human health or the environment has been proved; alternatives to current disposal methods; the costs of such alternatives; the impact of those alternatives on the use of natural resources; and the current and potential utilization of such materials. In addition, the report includes a review of applicable state and federal regulations so that regulatory decisions that derive from the report will avoid duplication of existing requirements.

NTIS

*Combustion; Fossil Fuels; Combustion Products; Petroleum Products; Coal; Environment Effects; Air Pollution*

**20070013867** Environmental Quality Management, Inc., Durham, NC, USA

**Case Study Demonstrating US EPA Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities: Rose Hill Regional Landfill, South Kingstown, Rhode Island**

Oct. 2005; 182 pp.; In English

Report No.(s): PB2007-107183; No Copyright; Avail.: National Technical Information Service (NTIS)

This report describes a case study that applies EPA-600/R-05/123C the guidance for conducting air pathway analyses of landfill gas emissions that are of interest to superfund remedial project managers, on-scene coordinators, facility owners, and potentially responsible parties. The particular site examined for this case study was the Rose Hill Regional Landfill in South Kingstown, RI. The case study exemplifies the use of the procedures and tools described in the guidance for evaluating LFG emissions to ambient air. The air pathway analysis is used to evaluate the inhalation risks to offsite receptors as well as the hazards of both onsite and offsite methane explosions and landfill fires. Landfill gases detected at the site were methane and chemicals of particular concern (COPCs) that encompassed nonmethane organic compounds, 1,1,1-trichloroethane, benzene, chlorobenzene, chloroethane, dichlorobenzene, methylene chloride, toluene, trichloroethene, vinyl chloride, and xylenes. The report includes values of 90th percentile concentration of COPCs and isopleths of the COPC concentrations overlaid on an aerial photograph of the site.

NTIS

*Exhaust Emission; Exhaust Gases; Landfills; Environmental Cleanup; Hazards*

**20070013872** Environmental Protection Agency, Washington, DC, USA

**Acid Rain Hourly Emissions Data 2006 (Raw Data File on CD-ROM)**

January 2006; In English

Report No.(s): PB2007-500022; No Copyright; Avail.: National Technical Information Service (NTIS)

This product of 2 CD-ROM's contains data on emissions from fossil fuel-fired electric power plants, which was collected

by the EPA Acid Rain Program under 40 CFR 75. Pollutants monitored include sulfur dioxide, nitrogen oxides, and carbon dioxide. The pollutants are generally monitored using continuous emissions monitoring systems (CEMS) on an hourly basis. Also included is general operating data, including operating time, heat input, and gross unit load. There is also information on the unit's monitoring plan, and the results of tests required to be performed by the source to insure that its monitoring equipment is functioning properly. Electric utilities, energy consultants, and power marketing companies can use EPA Acid Rain Program emissions data to project future SO<sub>2</sub> allowance costs and availability. Academic institutions can perform data modeling to evaluate environmental benefits and estimate health effects of SO<sub>2</sub> reductions. EPA and other agencies use it to try to correlate the reduction of SO<sub>2</sub> emissions with a decrease in acid precipitation, and also to measure the impacts of other existing and proposed emissions trading programs (e.g., for NO<sub>x</sub> and CO<sub>2</sub>).

NTIS

*Acid Rain; Air Pollution; Electric Generators; Pollution Monitoring*

**20070013899** Environmental Quality Management, Inc., Durham, NC, USA

**Case Study Demonstrating US EPA Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities: Bush Valley Landfill, Harford County, Maryland**

Oct. 2005; 364 pp.; In English

Report No.(s): PB2007-107184; No Copyright; Avail.: National Technical Information Service (NTIS)

This report describes a case study that applies EPA-600/R-05/123C the guidance for conducting air pathway analyses of landfill gas emissions that are of interest to superfund remedial project managers, on-scene coordinators, facility owners, and potentially responsible parties. The particular site examined for this case study was the Bush Valley Landfill in Harford County, MD. This site has a flexible membrane liner, 5 passive vents, and 17 monitoring probes. The case study exemplifies the use of the procedures and tools described in the guidance for evaluating LFG emissions to ambient air. The air pathway analysis is used to evaluate the inhalation risks to offsite receptors as well as the hazards of both onsite and offsite methane explosions and landfill fires. Landfill gases detected at the site were methane and chemicals of particular concern (COPCs) that encompassed 1,1,1-trichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, benzene, chlorobenzene, 1,4-dichlorobenzene, chloroethane, dichlorobenzene, methylene chloride, toluene, trichloroethene, vinyl chloride, and xylenes. The report includes values of 90th percentile concentration of COPCs and isopleths of the COPC concentrations overlaid on an aerial photograph of the site.

NTIS

*Exhaust Emission; Exhaust Gases; Landfills; Maryland; Environment Protection*

**20070013901** Vanderbilt Univ., Nashville, TN, USA, ARCADIS Geraghty and Miller, Inc., Durham, NC, USA

**Characterization of Mercury-Enriched Coal Combustion Residues from Electric Utilities Using Enhanced Sorbents for Mercury Control**

Sanchez, F.; Keeney, R.; Kosson, D.; Delapp, R.; Feb. 2006; 222 pp.; In English

Report No.(s): PB2007-107185; No Copyright; Avail.: National Technical Information Service (NTIS)

This report evaluates changes that may occur to coal-fired power plant air pollution control residues from the use of activated carbon and other enhanced sorbents for reducing air emissions of mercury and evaluates the potential for captured pollutants leaching during the disposal or use of these residues. Leaching of mercury, arsenic, and selenium during land disposal or beneficial use of coal combustion residues (CCRs) is the environmental impact pathway evaluated in this report.

NTIS

*Air Pollution; Coal; Combustion; Pollution Control; Residues; Sorbents; Utilities; Mercury (Metal)*

**20070013924** Environmental Protection Agency, Washington, DC, USA

**Symposium of Energy and Human Health: Human Costs of Electric Power Generation**

May 1979; 581 pp.; In English

Report No.(s): PB2007-106182; EPA 600/9-80/030; No Copyright; Avail.: CASI: [A25](#), Hardcopy

The Ohio River Basin Energy Study is a multi-disciplinary project of considerable magnitude, supported by a grant from the Environmental Protection Agency. It is concerned with present and future energy-environmental relationships in the Ohio River Basin; a tremendous resource which, as Senator Bayh described it in his address, is shared by the people of six states: Illinois, Indiana, Kentucky, Ohio, West Virginia and Pennsylvania. A major concern of ORBES is the health component of energy resource extraction, transportation, conversion (i.e. burning of coal and reactor operation) and transmission. In order to establish a sound 'state of knowledge' base it was decided to organize a three-day symposium devoted exclusively to the

energy-health relationship. The six sessions were devoted to: (1) occupational problems in coal and uranium mining; (2) methodological problems in detecting health effects; (3) health aspects of fossil-fueled power plants; (4) health aspects of transportation and transmission; (5) health problems in nuclear power generation; and (6) future areas of concern.

NTIS

*Conferences; Costs; Electric Generators; Public Health; Nuclear Electric Power Generation*

**20070013930** Pechan (E. H.) and Associates, Inc., Durham, NC, USA

**SPECIATE 4.0: Speciation Database Development Documentation, Final Report**

Hsu, Y.; Strait, R.; Roe, S.; Holoman, D.; Nov. 2006; 377 pp.; In English

Contract(s)/Grant(s): EP-D-06-001

Report No.(s): PB2007-107190; No Copyright; Avail.: CASI: [A17](#), Hardcopy

SPECIATE is the U.S. Environmental Protection Agency's (EPA) repository of total organic compound (TOC) and particulate matter (PM) speciation profiles of air pollution sources. Among the many uses of speciation data, these source profiles are used to: (1) create speciated emissions inventories for regional haze, particulate matter with an aerodynamic diameter less than 2.5 micrometers (PM<sub>2.5</sub>), and ozone (O<sub>3</sub>) air quality modeling; (2) estimate hazardous and toxic air pollutant emissions from total PM and TOC primary emissions; (3) provide input to chemical mass balance (CMB) receptor models; and, (4) verify profiles derived from ambient measurements using multivariate receptor models (e.g., factor analysis and positive matrix factorization). This report documents how EPA developed the SPECIATE 4.0 database that replaces the prior version of the SPECIATE database (i.e., SPECIATE 3.2) that was posted to EPA's Clearinghouse for Inventories & Emissions Factors (CHIEF) web site in November 2002. SPECIATE 4.0 includes a total of 4,080 PM and TOC profiles (2,019 new profiles and 2,071 profiles carried forward from SPECIATE 3.2). SPECIATE 4.0 includes 1,361 new PM profiles (of which 95 are simplified profiles and 47 are composite profiles) and 648 TOC profiles (of which 11 are composite profiles).

NTIS

*Data Bases; Organic Compounds; Particulates*

**20070014705** Pacific Northwest National Lab., Richland, WA, USA

**Specification of Selected Performance Monitoring and Commissioning Verification Algorithms for CHP Systems**

Brambley, M. R.; Katimpamula, S.; Oct. 01, 2006; 76 pp.; In English

Report No.(s): DE2006-896343; PNNL-16068; No Copyright; Avail.: National Technical Information Service (NTIS)

Pacific Northwest National Laboratory (PNNL) is assisting the U.S. Department of Energy (DOE) Distributed Energy (DE) Program by developing advanced control algorithms that would lead to development of tools to enhance performance and reliability, and reduce emissions of distributed energy technologies, including combined heat and power technologies. This report documents phase 2 of the program, providing a detailed functional specification for algorithms for performance monitoring and commissioning verification, scheduled for development in FY 2006. The report identifies the systems for which algorithms will be developed, the specific functions of each algorithm, metrics which the algorithms will output, and inputs required by each algorithm.

NTIS

*Algorithms; Program Verification (Computers)*

**20070014706** Pacific Northwest National Lab., Richland, WA, USA

**Regional Atmospheric Transport Code for Hanford Emission Tracking, Version 2 (RATCHET2). RATCHET2: Modification and Implementation of RATCHET for Use in SAC**

Ramsdell, J. V.; Rishel, J. P.; Jul. 2006; 88 pp.; In English

Report No.(s): DE2006-896360; PNNL-16071; No Copyright; Avail.: National Technical Information Service (NTIS)

This manual describes the atmospheric model and computer code for the Atmospheric Transport Module within SAC. The Atmospheric Transport Module, called RATCHET2, calculates the time-integrated air concentration and surface deposition of airborne contaminants to the soil. The RATCHET2 code is an adaptation of the Regional Atmospheric Transport Code for Hanford Emissions Tracking (RATCHET). The original RATCHET code was developed to perform the atmospheric transport for the Hanford Environmental Dose Reconstruction Project. Fundamentally, the two sets of codes are identical; no capabilities have been deleted from the original version of RATCHET. Most modifications are generally limited to revision of the run-specification file to streamline the simulation process for SAC.

NTIS

*Atmospheric Circulation; Manuals; Nuclear Fuels*

**20070014715** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA

**Evaluation of Catalytic Emission Controls to Prevent Carbon Monoxide Poisonings from Houseboat Generator Exhaust**

Earnest, G. S.; Hall, R. M.; Garcia, A.; McCleery, R.; Oct. 2006; 32 pp.; In English

Report No.(s): PB2007-107267; NIOSH-EPHB-171-38A; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Working under an interagency agreement with the USA Coast Guard, researchers from the National Institute for Occupational Safety and Health (NIOSH) evaluated carbon monoxide (CO) emissions, exposures, and controls from gasoline-powered generators on houseboats. This evaluation was part of a series of studies conducted by NIOSH investigators during the past several years to identify and recommend effective engineering controls to reduce the CO hazard and prevent CO poisonings on houseboats and other recreational marine vessels. The performance of two (14-KW and 20-KW) Westerbeke, Safe-CO(TM) generators were tested after being used on rental houseboats for the boating season. Prior to performing the testing, a damaged oxygen sensor was replaced on the 14-KW generators and both old and new catalysts were evaluated. Each of the evaluated generators had between 1,000 and 3,000 hours of use and were equipped with catalytic converters and electronic fuel injection systems. A 12.5-KW Westerbeke generator was also tested that had been retrofitted with a Zenith electronic fuel injection (EFI) retrofit kit. Each of the engineering control devices were designed to improve generator performance and reduce CO emissions. The houseboat containing the 14-KW generator had been modified so that testing could be accomplished using either a side exhaust or stack exhaust configuration. The performance of the two Westerbeke Safe-CO(TM) generators used for a season of boating was impressive; average CO concentrations at various locations on the boat was generally below 5 parts per million (ppm). Peak CO concentrations were all well below 20 ppm. Both older and brand new catalysts were evaluated. The new catalysts seemed to perform slightly better than the ones used for a season. CO concentrations were slightly lower under the no load conditions as compared to loaded. CO concentrations measured directly in the exhaust stack were approximately 200 ppm for the fully warmed generator. That compares to CO concentrations NIOSH researchers measured which exceeded 10,000 ppm on older Westerbeke generators without the Safe-CO(TM) control systems. When comparing side versus stack exhaust, the lower stern deck in the side exhaust configuration resulted in slightly higher concentrations.

NTIS

*Carbon Monoxide; Control Equipment; Exhaust Emission; Pollution Control*

**20070014772** Science Applications International Corp., Fort Washington, PA, USA

**Annual RREL (Risk Reduction Engineering Laboratory) Hazardous Waste Research Symposium (19th). Held in Cincinnati, Ohio on April 13-15, 1993. Abstract Proceedings**

Apr. 1993; 272 pp.; In English; Annual RREL (Risk Reduction Engineering Laboratory) Hazardous Waste Research Symposium (19th), April 13 - 15, 1993. Abstract Proceedings, Cincinnati, Ohio

Contract(s)/Grant(s): EPA-68-C2-0148

Report No.(s): PB2007-107086; No Copyright; Avail.: CASI: [A12](#), Hardcopy

The Nineteenth Annual Risk Reduction Engineering Laboratory (RREL) Hazardous Waste Research Symposium was held in Cincinnati, Ohio, April 13-15, 1993. The purpose of this Symposium was to present the latest significant research findings from ongoing and recently completed projects funded by the Risk Reduction Engineering Laboratory and five Hazardous Substance Research Centers. These Proceedings are organized into three sections. Sections A and B contain extended abstracts of the paper presentations. Section C contains abstracts of the poster displays. Subjects include remedial action, treatment, and control technologies for waste disposal, landfill liner and cover systems, underground storage tanks, municipal solid waste and residuals management and demonstration and development of innovative/alternative treatment technologies for hazardous waste. Alternative technology subjects include pollution prevention, thermal destruction of hazardous wastes, field evaluations, existing treatment options, emerging treatment processes, and biosystems for hazardous waste destruction. Drinking water treatment/management, corrosion, organics removal, health effects, and ultra-filtration are also addressed in the presentations.

NTIS

*Conferences; Hazardous Materials; Hazardous Wastes; Risk; Waste Management*

**20070014774** ManTech Environmental Technology, Inc., Research Triangle Park, NC, USA, Ceskoslovenska Akademie Ved, Prague, Czechoslovakia

**Ostrava Human Exposure and Biomarker Study**

Williams, R. W.; Watts, R. R.; Hartlage, T. A.; Phillips, L.; Lewtas, J.; Aug. 1997; 72 pp.; In English

Contract(s)/Grant(s): EPA-68-D50049

Report No.(s): PB2007-107089; No Copyright; Avail.: CASI: [A04](#), Hardcopy



A four week repeated measures personal air pollution exposure study was conducted in the city of Ostrava, Czech Republic, during October and November 1995. Personal exposure monitoring with 30 participants was conducted to determine the relationship between individual air particulate exposures and subsequent biomarkers of exposure and dose to DNA (not reported here). The 24 hour exposure periods for each individual were divided into day time at the central work site (KHS-Ostrava) and night time (e.g., at home) away from the central work site. Each individual was repeatedly monitored one day per week for four weeks. Individual blood and urine specimens, along with a 24 hour activity log, were collected in addition to fine ambient air particulate matter during each sampling period. Stationary indoor and outdoor monitoring of fine ambient air particulate matter at the central site was also conducted. Outdoor ambient monitoring at several sites across the city of Ostrava was conducted simultaneously.

NTIS

*Air Pollution; Biomarkers; Exposure; Human Beings*

**20070014778** Environmental Protection Agency, Washington, DC, USA

**Handbook on Pollution Prevention Opportunities for Bleached Kraft Pulp and Paper Mills**

Jun. 1993; 77 pp.; In English

Report No.(s): PB2007-107053; EPA/600/R-93/098; No Copyright; Avail.: CASI: [A05](#), Hardcopy

This handbook examines the current state of the art, the economics of adoption, and the level of adoption, of selected pollution prevention technologies in the U.S. pulp and paper industry. The focus in the handbook is on the bleached kraft segment of the pulp and paper industry, due to the heightened concern over its environmental impacts. This concern is related primarily to the use of chlorine-based compounds in the manufacture of bleached pulps, and the nature of the byproduct pollutants associated with conventional pulp making processes. In particular, it is the persistence, non-biodegradability, and toxicity of some of the chlorinated organic compounds formed during chlorine-based bleaching that explains the high level of attention directed toward this segment of the industry. The bleached kraft segment accounts for approximately 35 percent of the pulp mills and 47 percent of the pulp production capacity in the U.S. industry.

NTIS

*Bleaching; Handbooks; Industries; Kraft Process (Woodpulp); Pollution Control*

**20070014784** Sunflower Electric Power Corp., Hays, KS, USA

**Achieving New Source Performance Standards (NSPS) Emission Standards through Integration of Low-NOx Burners with an Optimization Plan for Boiler Combustion. (Report for September 2001-September 2005). (Reissue date, June 2006)**

Penrod, W.; Jun. 2006; 65 pp.; In English

Report No.(s): DE2006-896675; No Copyright; Avail.: National Technical Information Service (NTIS)

The objective of this project was to demonstrate the use of an Integrated Combustion Optimization System to achieve NOX emission levels in the range of 0.15 to 0.22 lb/MMBtu while simultaneously enabling increased power output. The project plan consisted of the integration of low-NOX burners and advanced overfire air technology with various process measurement and control devices on the Holcomb Station Unit 1 boiler. The plan included the use of sophisticated neural networks or other artificial intelligence technologies and complex software to optimize several operating parameters, including NOX emissions, boiler efficiency, and CO emissions. The program was set up in three phases. In Phase I, the boiler was equipped with sensors that can be used to monitor furnace conditions and coal flow to permit improvements in boiler operation. In Phase II, the boiler was equipped with burner modifications designed to reduce NOX emissions and automated coal flow dampers to permit on-line fuel balancing. In Phase III, the boiler was to be equipped with an overfire air system to permit deep reductions in NOX emissions. Integration of the overfire air system with the improvements made in Phases I and II would permit optimization of boiler performance, output, and emissions. This report summarizes the overall results from Phases I and II of the project. A significant amount of data was collected from the combustion sensors, coal flow monitoring equipment, and other existing boiler instrumentation to monitor performance of the burner modifications and the coal flow balancing equipment.

NTIS

*Boilers; Burners; Coal; Exhaust Emission; Exhaust Gases; Nitrogen Oxides; Pollution Control; Combustion Efficiency*



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*.

**20070013863** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Self-Consistent Ring Current/Electromagnetic Ion Cyclotron Waves Modeling**

Khazanov, G. V.; Gamayunov, K. V.; Gallagher, D. L.; December 15, 2006; 1 pp.; In English; Fall AGU 2006 Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The self-consistent treatment of the RC ion dynamics and EMIC waves, which are thought to exert important influences on the ion dynamical evolution, is an important missing element in our understanding of the storm-and recovery-time ring current evolution. For example, the EMIC waves cause the RC decay on a time scale of about one hour or less during the main phase of storms. The oblique EMIC waves damp due to Landau resonance with the thermal plasmaspheric electrons, and subsequent transport of the dissipating wave energy into the ionosphere below causes an ionosphere temperature enhancement. Under certain conditions, relativistic electrons, with energies 21 MeV, can be removed from the outer radiation belt by EMIC wave scattering during a magnetic storm. That is why the modeling of EMIC waves is critical and timely issue in magnetospheric physics. This study will generalize the self-consistent theoretical description of RC ions and EMIC waves that has been developed by Khazanov et al. [2002, 2003] and include the heavy ions and propagation effects of EMIC waves in the global dynamic of self-consistent RC - EMIC waves coupling. The results of our newly developed model that will be presented at the meeting, focusing mainly on the dynamic of EMIC waves and comparison of these results with the previous global RC modeling studies devoted to EMIC waves formation. We also discuss RC ion precipitations and wave induced thermal electron fluxes into the ionosphere.

Author

*Electromagnetic Radiation; Ion Cyclotron Radiation; Ring Currents; Self Consistent Fields; Models*

**20070013991** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Plasmapause Equatorial Shape Determination via the Minimum L Algorithm: Description and Evaluation**

Newman, Timothy S.; Wang, C.; Newman, T. S.; Gallagher, D. L.; November 30, 2006; 2 pp.; In English; Copyright; Avail.: Other Sources; Abstract Only

The Minimum L Algorithm for determining the equatorial shape of the plasmapause using NASA IMAGE Extreme Ultraviolet (EUV) imagery is described and analyzed. The algorithm operates without human intervention given a single EUV image in which the plasmasphere silhouette boundary has been identified. For each line of sight (LOS) through pixels on the 13 plasmasphere silhouette boundary, the algorithm first finds all magnetic dipole 14 field lines intersected by the LOS and then returns as the plasmasphere s boundary the field line with the minimum L value. The analysis considers the reasonableness, applicability, and accuracy of the algorithm and contrasts it with 17 the well-known Edge Algorithm is also introduced. Application of all three algorithms to real EUV imagery is demonstrated.

Author

*Algorithms; Plasmapause; Shapes; Numerical Analysis; Geophysics*

**20070013995** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Geomagnetic Activity Indicates Large Amplitude for Sunspot Cycle 24**

Hathaway, David H.; August 22, 2006; 1 pp.; In English; 2006 AGU Fall Meeting, 11-14 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The level of geomagnetic activity near the time of solar activity minimum has been shown to be a reliable indicator for the amplitude of the following solar activity maximum. The geomagnetic activity index aa can be split into two components: one associated with solar flares, prominence eruptions, and coronal mass ejections which follows the solar activity cycle and a second component associated with recurrent high speed solar wind streams which is out of phase with the solar activity cycle. This second component often peaks before solar activity minimum and has been one of the most reliable indicators for the amplitude of the following maximum. The size of the recent maximum in this second component indicates that solar activity cycle 24 will be much higher than average - similar in size to cycles 21 and 22 with a peak smoothed sunspot number of 160 plus or minus 25.

Author

*Geomagnetism; Solar Activity; Geophysics; Solar Wind*

**METEOROLOGY AND CLIMATOLOGY**

Includes weather observation forecasting and modification.

**20070013756** Eastern Research Group, Inc., Morrisville, NC USA

**Urban Air Toxics Monitoring Program (UATMP), 2005**

Dec. 2006; 2992 pp.; In English

Contract(s)/Grant(s): 68-D-03-049

Report No.(s): PB2007-106576; EPA-454/R-07-001; No Copyright; Avail.: National Technical Information Service (NTIS)

This report presents the results and conclusions from the ambient air monitoring conducted as part of the 2005 Urban Air Toxics Monitoring Program (UATMP)Ca program designed to characterize the magnitude and composition of potentially toxic air pollution in, or near, urban locations. The 2005 UATMP included 47 monitoring stations that collected 24-hour air samples, typically on a 6- or 12-day schedule plus special monitoring in the aftermath of Hurricane Katrina. Forty-six sites analyzed ambient air samples for concentrations of 60 volatile organic compounds (VOC) and/or 15 carbonyl compounds. Thirteen sites also analyzed for 80 speciated nonmethane organic compounds (SNMOC). Six sites analyzed for 19 semivolatile compounds (SVOC) while fifteen sites analyzed 11 metal compounds. Overall, nearly 170,000 ambient air concentrations were measured during the 2005 UATMP. An additional 34,000 ambient air concentrations were added due to Hurricane Katrina sampling. The summary presented in this report uses various graphical, numerical, and statistical analyses to put the vast amount of ambient air monitoring data collected into perspective. Not surprisingly, the ambient air concentrations measured during the program varied significantly from city to city and from season to season. This report describes and interprets these spatial and temporal variations separately for halogenated hydrocarbons, hydrocarbons, polar compounds, and carbonyls. The ambient air monitoring data collected during the 2005 UATMP serve a wide range of purposes. Not only do these data characterize the nature and extent of urban air pollution close to the 47 monitoring stations participating in this study, but they also indicate some trends and patterns that may be common to all urban environments. Therefore, this report presents some results that are specific to particular monitoring locations and presents other results that are apparently common to urban environments. These results should ultimately provide additional insight into the complex nature of urban air pollution. The final data are also included in the appendices to this report.

NTIS

*Air Pollution; Air Quality; Air Sampling; Ambience; Environmental Monitoring; Pollution Monitoring; Toxicity*

**20070013776** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Evidence for Interannual to Decadal Variations in Hadley and Walker Circulations and Links to Water and Energy Fluxes**

Robertson, Franklin; Bosilovich, Michael; Miller, Timothy; [2007]; 1 pp.; In English; 87th Annual AMS Meeting, 14-18 Jan. 2007, San Antonio, TX, USA; No Copyright; Avail.: Other Sources; Abstract Only

Mass and energy transports associated with the Hadley and Walker circulations are important components of the earth's climate system and are strongly linked to hydrologic processes. Interannual to decadal variation in these flows likely signify a combination of natural climate noise as well as a response to anthropogenic forcing. There remains considerable uncertainty in quantifying variations in these flows. Evidence in the surface pressure record supports a weakening of the Walker circulation over the Pacific in recent decades. Conversely the NCEP / NCAR and ERA 40 reanalyses indicate that the Hadley circulation has increased in strength over the last two decades, though these analyses depict significantly different mass circulation changes. Interestingly, the NCEP - II / DOE reanalysis contains essentially no Hadley circulation changes. Most climate model integrations anticipate a weakening of both tropical circulations associated with stronger static stability. Clearly there is much uncertainty not only with the mass transports, but also how they are linked to water and energy balance of the planet through variations in turbulent heat and radiative fluxes and horizontal exports / imports of energy. Here we examine heat and water budget variations from a number of reanalysis products and focus on the linear and nonlinear response of ENSO warm and cold events as opportunities to study budget variations over the past 15-20 years. Our analysis addresses such questions as To what extent do Hadley and Walker Cell variations compensate each other on mass and energy transport? Do static stability adjustments appear to constrain fractional precipitation response vs. fractional water vapor response? We appeal to constraints offered by GPCP precipitation, SSWI ocean evaporation estimates, and ISCCP-FD radiative fluxes, and other satellite data sets to interpret and confirm reanalysis-based diagnostics. Using our findings we also attempt to place in context the recent findings

that tropical ocean evaporation increased by order 5% or more during the 1990s, reconciling this with GPCP precipitation variations.

Author

*Energy Budgets; Water; Annual Variations; Climatology; Atmospheric Circulation*

**20070013782** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Washington D.C. Lightning Mapping Array Demonstration Project Risk Reduction for GOES Lightning Mapper Data**

Smith, Stephan B.; Goodman, Steven; Krehbiel, Paul; [2007]; 1 pp.; In English; 87th Annual AMS Meeting, 14-18 Jan. 2007, San Antonio, TX, USA; Copyright; Avail.: Other Sources; Abstract Only

A 10-site, ground-based total lightning mapping array (LMA) has been installed in the Washington D.C. metropolitan area in 2006. The total lightning data from DC LMA are being processed in real-time and derived products are being provided to the forecasters of the National Weather Service (NWS) forecast office in Sterling, Virginia. The NWS forecasters are using the products to monitor convective activity along with conventional radar and satellite products. Operational experience with these products is intended to inform decision making in how to best utilize in NWS operations similar data available from the GOES Lightning Mapper. The paper will discuss specifics of the LMA as well as proposed research into use of total lightning data in predicting and warning for cloud-to-ground lightning.

Author

*Cloud-to-Ground Discharges; Lightning; Decision Making; Predictions; Forecasting; Real Time Operation; Convection*

**20070013783** NASA Marshall Space Flight Center, Huntsville, AL, USA

**OTD Observations of Continental US Ground Flashes Detected by NLDN**

Koshak, William J.; Boccippio, Dennis J.; [2007]; 1 pp.; In English; 2006 Fall AGU Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Lightning optical flash parameters (e.g., radiance, area, duration, number of optical groups, and number of optical events) derived from almost 5 yrs of Optical Transient Detector (OTD) data are compared with peak current and multiplicity observations derived from the US National Lightning Detection Network (NLDN). Despite the relatively low lightning geolocation accuracy afforded by OTD, a total of 48,870 NLDN cloud-to-ground (CG) flashes were correlated with OTD flashes, or about 10,000 CGs per year. The median values of the above OTD flash parameters for the 48,870 CGs were, respectively: 0.137 J/square meters/st/micrometers, 313.7 square kilometers, 0.189 s, 4 optical groups per CG, and 8 optical events per CG. Invoking the multiplicity data, the median number of optical groups per stroke was 2.5, and the median number of optical events per stroke was 5.0. Median values of peak current for negative and positive CGs were -21.6 kA and 17.8 kA, respectively, and as expected, the negative CGs had a larger average multiplicity than the positive CGs. A statistical summary is provided for all CGs, for positive and negative CGs, and for CGs from different seasons. Standard two-distribution hypothesis tests were performed to intercompare the population means of the various lightning parameters. In particular, and to greater than the 99% confidence level, it was found that positive CGs are on average more radiant, of greater areal extent, and are longer lasting than negative CGs. Rankings from a complete set of hypothesis tests between CGs of different polarities and from different seasons are also provided. Most notably, wintertime positive CGs tend to be more radiant, of greater areal extent, and longer lasting than any other group of CGs (i.e., negative springtime CGs, positive summertime CGs, etc.).

Author

*Detection; Lightning; Earth Sciences; Atmospheric Electricity; Surges*

**20070013787** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Variations in Upper-Tropospheric Humidity and Convective Processes as Seen from SSM/T-2**

Robertson, Franklin R.; Fitzjarrald, Dan E.; [2007]; 1 pp.; In English; 2006 AGU Fall Meeting: Coordinated Observation and Modeling of Global Water Vapor Variability and Its Feedback to Climate, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Water vapor feedback, particularly involving water vapor in the upper troposphere (UTH), is widely regarded as the process with the most potential to amplify anthropogenic greenhouse forcing. Yet, our ability to quantify observationally water vapor variations in the current climate and the relationships to convective processes remains rather crude. Remote sensing from polar orbiting instruments has played a major role in documenting UTH variability, supplementing highly undersampled and poorly calibrated rawinsonde measurements. Most of our observational understanding of UTH has come from the 6.7 micrometer channel measurements which are subject to cloud contamination uncertainties. In this work we examine UTH variations present in the Special Sensor Microwave Temperature Sounder 2 (SSM/T-2) sensors flying aboard Defense Military

Satellite Program (DMSP) polar orbiting satellites during the period 1993 through 2001. We employ data from the the 183.3 +/- 1 GHz channel which is far less sensitive to cirrus than IR methods. Our primary focus is on obtaining more reliable statistics of interannual behavior; i.e. How close to constant RH are interannual variations in T2 UTH over the tropics? How do temperature and moisture variations contribute regionally? The 1997/1998 strong ENSO warming event and adjacent cool periods provide a strong signal to study, albeit a perturbation of natural climate variability. Modeling the 183.3 GHz channel using reanalysis temperature data, but with climatological water vapor, allows us to infer the separate contribution by water vapor in the observations. In addition, frozen hydrometeors produced by deep convection are also captured in the 150 GHz oxygen channel, providing an opportunity to relate the incidence of deep convection to water vapor variability. Our results indicate a much larger variation of 183.3 GHz brightness temperatures would be observed were it not for water vapor variations positively correlated with tropical SSTs. Comparisons are made with previous studies using both IR and microwave observations to characterize UTH response to tropical SSTs.

Author

*Water Vapor; Troposphere; Greenhouse Effect; Convection; Climatology; Microwave Radiometers; Temperature Profiles; Remote Sensing*

**20070013795** NASA Marshall Space Flight Center, Huntsville, AL, USA

**First Results from the Washington D.C. Metropolitan Area Lightning Map Demonstration Project**

Goodman, Steven J.; Blakeslee, Richard J.; Hall, John; Krehbiel, Paul; Rison, Bill; Zubrick, Steven; [2007]; 1 pp.; In English; 2006 Fall AGU Meeting, Physics and Detection of Thunderstorm Electrification and Lightning, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

An experimental portable lightning mapping array (LMA) operating in the upper VHF TV band (Channels 7-13; 174-216 MHz) was deployed in the Washington DC Metropolitan area during the summer 2006 to locate and monitor the overall lightning activity. The LMA network provides total lightning data to support lightning research as well as proxy data to benefit the development of applications for planned observing systems such as the GOES-R Geostationary Lightning Mapper. The portable LMA hardware is a compactly-housed, easily deployed version of the LMA stations installed North Alabama, Oklahoma, and New Mexico, which operate in the lower VHF TV band (Channels 2-6, 54-88 MHz). Real-time LMA data products are provided to the National Weather Service Weather Forecast Office (WFO) in Sterling, VA to aid in their forecast and warning operations. Forecasters at WFO Sterling have already found the lightning data from the Washington DC demonstration network to be very useful in assessing the development of storm systems. On July 4, 2006, data from the LMA aided forecasters as they monitored an area of convection that later developed into a line of severe storms that moved southward through the Washington DC metropolitan area across the Washington Mall. Additional applications of lightning mapping data in the Baltimore-Washington DC urban environment will be discussed.

Author

*Lightning; Storms (Meteorology); Real Time Operation; Illuminating; Forecasting*

**20070013848** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Washington DC Metro Area Lightning Mapping Array**

Krehbiel, Paul; Rison, William; Edens, Harald; OConnor, Nicholas; Aulich, Graydon; Thomas, Ronald; Kieft, Sandra; Goodman, Steven; Blakeslee, Richard; Hall, John; Bailey, Jeff; December 15, 2006; 1 pp.; In English; 2006 Fall American Geophysical Union Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

During the spring and summer of 2006, a network of eight lightning mapping stations has been set up in the greater DC metropolitan area to monitor the total lightning activity in storms over Virginia, Maryland and the Washington DC area. The network is a joint project between New Mexico Tech, NASA, and NOAA/National Weather Service, with real-time data being provided to the NWS for use in their forecast and warning operations. The network utilizes newly available portable stations developed with support from the National Science Foundation. Cooperating institutions involved in hosting mapping stations are Howard University, Montgomery County Community College in Rockville MD, NOAA/NWS's Test and Evaluation Site in Sterling, VA, College of Southern Maryland near La Plata MD, the Applied Physics Laboratory of Johns Hopkins University, Northern Virginia Community College in Annandale, VA, the University of Maryland at Baltimore County, and George Mason University (Prince William Campus) in Manassas, VA. The network is experimental in that its stations a) operate in the upper rather than the lower VHF (TV channel 10, 192-198 MHz) to reduce the radio frequency background noise associated with urban environments, and b) are linked to the central processing site via the internet rather than by dedicated wireless communication links. The central processing is done in Huntsville, AL, and updated observations are sent to the National Weather Service every 2 min. The observational data will also be available on a public website. The higher



operating frequency results in a decrease in signal strength estimated to be about 15-20 dB, relative to the LMA networks being operated in northern Alabama and central Oklahoma (which operate on TV channels 5 and 3, respectively). This is offset somewhat by decreased background noise levels at many stations. The receiver threshold levels range from about -95 dBm up to -80 dBm and the peak lightning signals typically extend 15-20 dB above the threshold values. Despite having decreased sensitivity, the network locates lightning in plan position over all of Maryland and Delaware, much of Virginia, and into Southern Pennsylvania and New Jersey. 3-D coverage is provided out to 100-150 km range from the Sterling WFO including the 3 major DC commercial airports (Reagan National, Dulles International, and Baltimore Washington International). The network will eventually consist of 10 or more stations, which will extend and improve its coverage.

Author

*Lightning; Storms (Meteorology); Mapping; Arrays; District of Columbia; Communication Networks*

**20070013861** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **The Impact of Atmospheric InfraRed Sounder (AIRS) Profiles on Short-term Weather Forecasts**

Chou, Shih-Hung; Zavodsky, Brad; Jedlovec, Gary J.; Lapenta, William; Jan. 18, 2007; 1 pp.; In English; 11th Conference on Integrated Observing and Assimilation Systems for Atmosphere, Oceans, and Land Surface, 14-18 Jan. 2007, san Antonio, TX, USA; Copyright; Avail.: Other Sources; Abstract Only

The Atmospheric Infrared Sounder (AIRS), together with the Advanced Microwave Sounding Unit (AMSU), represents one of the most advanced spacebased atmospheric sounding systems. The combined AIRS/AMSU system provides radiance measurements used to retrieve temperature profiles with an accuracy of 1 K over 1 km layers under both clear and partly cloudy conditions, while the accuracy of the derived humidity profiles is 15% in 2 km layers. Critical to the successful use of AIRS profiles for weather and climate studies is the use of profile quality indicators and error estimates provided with each profile. Aside from monitoring changes in Earth's climate, one of the objectives of AIRS is to provide sounding information of sufficient accuracy such that the assimilation of the new observations, especially in data sparse region, will lead to an improvement in weather forecasts. The purpose of this paper is to describe a procedure to optimally assimilate high-resolution AIRS profile data in a regional analysis/forecast model. The paper will focus on the impact of AIRS profiles on a rapidly developing east coast storm and will also discuss preliminary results for a 30-day forecast period, simulating a quasi-operation environment. Temperature and moisture profiles were obtained from the prototype version 5.0 EOS science team retrieval algorithm which includes explicit error information for each profile. The error profile information was used to select the highest quality temperature and moisture data for every profile location and pressure level for assimilation into the ARPS Data Analysis System (ADAS). The AIRS-enhanced analyses were used as initial fields for the Weather Research and Forecast (WRF) system used by the SPORT project for regional weather forecast studies. The ADASWRF system will be run on CONUS domain with an emphasis on the east coast. The preliminary assessment of the impact of the AIRS profiles will focus on quality control issues associated with AIRS, intelligent use of the quality indicators, and forecast verification.

Author

*Infrared Instruments; Weather Forecasting; Atmospheric Sounding; Data Acquisition*

**20070013862** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **An Investigation of the Characterization of Cloud Contamination in Hyperspectral Radiances**

McCarty, William; Jedlovec, Gary J.; LeMarshall, John; January 18, 2007; 1 pp.; In English; 87th Annual Meeting of the American Meteorologist Society, 14-18 Jan. 2007, San Antonio, TX, USA; Copyright; Avail.: Other Sources; Abstract Only

In regions lacking direct observations, the assimilation of radiances from infrared and microwave sounders is the primary method for characterizing the atmosphere in the analysis process. In recent years, technological advances have led to the launching of more advanced sounders, particularly in the thermal infrared spectrum. With the advent of these hyperspectral sounders, the amount of data available for the analysis process has and will continue to be dramatically increased. However, the utilization of infrared radiances in variational assimilation can be problematic in the presence of clouds; specifically the assessment of the presence of clouds in an instantaneous field of view (IFOV) and the contamination in the individual channels within the IFOV. Various techniques have been developed to determine if a channel is contaminated by clouds. The work presented in this paper and subsequent presentation will investigate traditional techniques and compare them to a new technique, the CO<sub>2</sub> sorting technique, which utilizes the high spectral resolution of the Atmospheric Infrared Sounder (AIRS) within the framework of the Gridpoint Statistical Interpolation (GSI) 3DVAR system. Ultimately, this work is done in preparation for the assessment of short-term forecast impacts with the regional assimilation of AIRS radiances within the



analysis fields of the Weather Research and Forecast Nonhydrostatic Mesoscale Model (WRF-NMM) at the NASA Short-term Prediction Research and Transition (SPORT) Center.

Author

*Contamination; Radiance; Clouds (Meteorology); Weather Forecasting; Characterization*

**20070013912** Meteorological Satellite Center, Tokyo, Japan

**Monthly Report for the Meteorological Satellite Center: October 2006**

October 2006; In English; Copyright; Avail.: Other Sources

The CD-ROM concerning the October 2006 Monthly Report of the Meteorological Satellite Center (MSC) contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the Polar Orbital Meteorological Satellites operated by NOAA. The CD-ROM contains the following observation data: Full Disk Earth's Cloud Image; Cloud Image of Japan and its vicinity; Cloud Amount; Sea Surface Temperature; Cloud Motion Wind; Water Vapor Motion Wind; Equivalent Blackbody Temperature; OLR (Out-going Longwave Radiation), Solar Radiation; Snow and Ice Index; Orbit Data; Attitude Data; VISSR Image Data Catalog (Cartridge Magnetic Tape (CMT), Micro Film); TOVS (TIROS Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water; and TOVS Total Ozone Amount.

Derived from text

*Satellite Observation; Satellite Sounding; Atmospheric Sounding; Meteorological Parameters; Satellite Imagery; Japan*

**20070013913** Meteorological Satellite Center, Tokyo, Japan

**Monthly Report for the Meteorological Satellite Center: November 2006**

November 2006; In English; Copyright; Avail.: Other Sources

The CD-ROM concerning the November 2006 Monthly Report of the Meteorological Satellite Center (MSC) contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the Polar Orbital Meteorological Satellites operated by NOAA. The CD-ROM contains the following observation data: Full Disk Earth's Cloud Image; Cloud Image of Japan and its vicinity; Cloud Amount; Sea Surface Temperature; Cloud Motion Wind; Water Vapor Motion Wind; Equivalent Blackbody Temperature; OLR (Out-going Longwave Radiation), Solar Radiation; Snow and Ice Index; Orbit Data; Attitude Data; VISSR Image Data Catalog (Cartridge Magnetic Tape (CMT), Micro Film); TOVS (TIROS Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water; and TOVS Total Ozone Amount.

Derived from text

*Satellite Observation; Satellite Sounding; Atmospheric Sounding; Meteorological Parameters; Satellite Imagery; Japan*

**20070013934** Forest Service, Rio Piedras, Puerto Rico

**Creating Cloud-Free Landsat ETM+ Data Sets in Tropical Landscapes: Cloud and Cloud-Shadow Removal**

Martinuzzi, S.; Gould, W. A.; Ramos Gonzalez, O. M.; Feb. 2007; 18 pp.; In English

Report No.(s): PB2007-107243; FSGTR-IITF-32; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Clouds and cloud shadows are common features of visible and infrared remotely-sensed images collected from many parts of the world, particularly in humid and tropical regions. We have developed a simple and semi-automated method to mask clouds and shadows in Landsat ETM+ imagery, and have developed a recent cloud-free composite of multitemporal images for Puerto Rico and its adjacent islands that can be used for a variety of landscape analyses. Our assumption is that if clouds and shadows can be identified in a reference image, they can be replaced with data from other dates. We created cloud masks by using Landsat ETM+ band 1 (blue) and thermal band 6.1. Additionally, Landsat ETM+ band 4 (near infrared) and parameters of sun angle, topography, and cloud-shadow projection were used for directing and masking shadows. This methodology was applied to a set of 18 images from 1999 to 2003 to develop an island-wide image that is 96.5 percent cloud free. We considered the seasonality of the imagery when selecting reference images and building the mosaic in order to minimize variation in reflectance related to dry or wet season canopy characteristics. We developed a higher resolution data set by merging the 15-m resolution panchromatic band with the 30-m resolution Landsat ETM+ data. The methodology developed is simple and straightforward to use wherever obtaining cloud-free image data sets is desirable and can be integrated into other efforts that demand an accurate method for the identification of clouds and shadows.

NTIS

*Imagery; Landsat Satellites; Meteorology; Remote Sensing; Satellite Imagery; Shadows; Tropical Regions*

**20070014069** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Diurnal Lightning Distributions as Observed by the Optical Transient Detector (OTD) and the Lightning Imaging Sensor (LIS)**

Blakeslee, R. J.; Bailey, J. C.; [2007]; 1 pp.; In English; 2006 Fall AGU Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

Data obtained from the OTD (April 1995 to March 2000) and LIS (December 1997 to December 2005) satellites (70 and 35 degree inclination low earth orbits, respectively) are used to statistically determine the number of flashes in the diurnal cycle both as a function of local and universal time. Also included are global flash density maps. The data is further subdivided by season, continental versus oceanic, night time versus day time, northern versus southern hemisphere, and other regions of interest such as the Brazilian rain forest and the Congo. The data includes corrections for detection efficiency and instrument view time. The data was compared with the 'Carnegie Curve' and the diurnal global thunderstorm contributions from thunderday statistics from different continents as derived by Whipple and Scrase, 1936. Initial results indicate that the northern hemisphere fall (September to November) has a larger amplitude than the northern hemisphere spring (March to May). This may be due to the differences in the contribution of the Brazilian rain forest during these periods (the main lightning peak starts in September and ends in February with a secondary peak in April). For some areas of the world, the peak of the diurnal curve appears to be shifted to later in the evening.

Author

*Thunderstorms; Lightning; Diurnal Variations; Imaging Techniques*

**20070014755** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Cloud Optical Depth Retrievals from Solar Background 'signal' of Micropulse Lidars**

Chiu, J. Christine; Marshak, A.; Wiscombe, W.; Valencia, S.; Welton, E. J.; [2007]; 14 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): DE-AI02-95ER61961; Copyright; Avail.: CASI: [A03](#), Hardcopy

Pulsed lidars are commonly used to retrieve vertical distributions of cloud and aerosol layers. It is widely believed that lidar cloud retrievals (other than cloud base altitude) are limited to optically thin clouds. Here we demonstrate that lidars can retrieve optical depths of thick clouds using solar background light as a signal, rather than (as now) merely a noise to be subtracted. Validations against other instruments show that retrieved cloud optical depths agree within 10-15% for overcast stratus and broken clouds. In fact, for broken cloud situations one can retrieve not only the aerosol properties in clear-sky periods using lidar signals, but also the optical depth of thick clouds in cloudy periods using solar background signals. This indicates that, in general, it may be possible to retrieve both aerosol and cloud properties using a single lidar. Thus, lidar observations have great untapped potential to study interactions between clouds and aerosols.

Author

*Cloud Physics; Optical Radar; Optical Thickness; Micropulsations; Background Radiation; Solar Radiation*

**20070014787** National Renewable Energy Lab., Golden, CO USA

**Great Plains Turbulence Environment: Its Origins, Impact and Simulation**

Kelley, N. D.; Johnkman, B. J.; Scott, G. N.; Dec. 2006; 24 pp.; In English

Report No.(s): DE2006-896716; NREL/CP-500-40176; No Copyright; Avail.: National Technical Information Service (NTIS)

This paper summarizes the known impacts of nocturnal turbulence on wind turbine performance and operations.

NTIS

*Great Plains Corridor (North America); Wind Turbines; Nocturnal Variations; Turbulence Effects*

## 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*.

**20070014087** NASA Johnson Space Center, Houston, TX, USA

**Persistent Seroconversion after Accidental Eye Exposure to Calcifying Nanoparticles**

Ciftcioglu, Neva; Aho, Katja M.; McKay, David S.; Kajander, E. Olavi; [2007]; 4 pp.; In English; Copyright; Avail.:

CASI: **A01**, Hardcopy

Biosafety of nanomaterials has attracted much attention recently. We report here a case where accidental human eye exposure to biogenic nanosized calcium phosphate in the form of calcifying nanoparticles (CNP) raised a strong IgG immune response against proteins carried by CNP. The antibody titer has persisted over ten years at the high level. The IgG was detected by ELISA using CNPs propagated in media containing bovine and human serum as antigen. The exposure incident occurred to a woman scientist (WS) at a research laboratory in Finland at 1993. CNP, also termed 'nanobacteria', is a unique self-replicating agent that has not been fully characterized and no data on biohazards were available at that time. Before the accident, her serum samples were negative for both CNP antigen and anti-CNP antibody using specific ELISA tests (Nanobac Oy, Kuopio, Finland). The accident occurred while WS was harvesting CNP cultures. Due to a high pressure in pipetting, CNP pellet splashed into her right eye. Both eyes were immediately washed with water and saline. The following days there was irritation and redness in the right eye. These symptoms disappeared within two weeks without any treatment. Three months after the accident, blood and urine samples of WS were tested for CNP cultures (2), CNP-specific ELISA tests, and blood cell counts. Blood cell counts were normal, CNP antigen and culture tests were negative. A high IgG anti-CNP antibody titer was detected (see Figure). The antibodies of this person have been used thereafter as positive control and standard in ELISA manufacturing (Nano-Sero IgG ELISA, Nanobac Oy, Kuopio, Finland).

Author

*Antibodies; Biological Hazards; Calcification; Calcium Phosphates; Eye (Anatomy); Nanoparticles*

**20070014795** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Thermococcus Thioreducens sp. Nov., a Novel Hyperthermophilic, Obligately Sulfur-reducing Archaeon from a Deep-sea Hydrothermal Vent**

Pikuta, Elena V.; Marsic, Damien; Itoh, Takashi; Bej, Asim K.; Tang, Jane; Whitman, William B.; Ng, Joseph D.; Garriott, Owen K.; Hoover, Richard B.; [2007]; 22 pp.; In English; Original contains black and white illustrations; Copyright;

Avail.: CASI: **C01**, CD-ROM: **A03**, Hardcopy

A hyperthermophilic, sulfur-reducing, organo-heterotrophic archaeon, strain OGL-20P was isolated from black smoker chimney material from the Rainbow hydrothermal vent site on the Mid-Atlantic Ridge (36.2 N, 33.9 W). The cells of strain OGL-20P(sup T) have an irregular coccoid shape and are motile with a single flagellum. Growth was observed within the pH range 5.0-8.5 (optimum pH 7.0), NaCl concentration range 1-5 % (w/v) (optimum 3%), and temperature range 55-94 C (optimum 83-85 C). The novel isolate is strictly anaerobic and obligately dependent upon elemental sulfur as an electron acceptor, but it does not reduce sulfate, sulfite, thiosulfate, iron (III) or nitrate. Proteolysis products (peptone, bacto-tryptone, casamino-acids, and yeast extract) are utilized as substrates during sulfur-reduction. Strain OGL-20P(sup T) is resistant to ampicillin, chloramphenicol, kanamycin, and gentamycin, but sensitive to tetracycline and rifampicin. The G+C content of DNA is 52.9 mol%. The 16S rRNA gene sequence analysis revealed that strain OGL-20P(sup T) is closely related to *Thermococcus coalescens* and related species, but no significant homology by DNA-DNA hybridization was observed between those species and the new isolate. On the basis of physiological and molecular properties of the new isolate, we conclude that strain OGL-20P(sup T) represents a new separate species within the genus *Thermococcus*, and propose the name *Thermococcus thioreducens* sp. nov. The type strain is OGL-20P(sup T) (= ATCC BAA-394(sup T) = JCM 12859(sup T) = DSM 14981(sup T)).

Author

*Submarine Hydrothermal Vents; Sulfur; Thermophiles; Heterotrophs; Genetics*

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*.

**20070014063** NASA Johnson Space Center, Houston, TX, USA

**Toxicity of Carbon Nanotubes and its Implications for Occupational and Environmental Health**

Lam, Chiu-wing; James, John T.; March 26, 2007; 46 pp.; In English; Heath Risk Carbon Nanotubes, Can We Learn from Mineral Fibers or Ultra-fine Particulates?, 26 Mar. 2007, Charlotte, NC, USA; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

This viewgraph document reviews the sources of Nano particles in the environment, the structure and properties of Carbon Nanotubes (CNTs), the physical characteristics of CNT materials, pulmonary and other health concerns of exposure to CNTs. The toxicity of CNT in rodents is summarized and some natural, and man-made sources of CNTs are shown. CNTs are electrically and thermally conductive, fibrous, biopersistent and very complicated in structures. The factors affecting toxicity of CNTs are more than size and surface area.

CASI

*Carbon Nanotubes; Toxicity; Toxic Hazards; Occupational Diseases; Public Health*

**20070014476** NASA Johnson Space Center, Houston, TX, USA

**Subclinical Reactivation and Shed of Infectious Varicella Zoster Virus in Saliva of Astronauts**

Cohrs, Randall J.; Mehta, Satish K.; Schmid, D. Scott; Gilden, Donald H.; Pierson, Duane L.; [2007]; 1 pp.; In English; International Herpesvirus Workshop, 7-12 Jul. 2007, Asheville, NC, USA; Copyright; Avail.: Other Sources; Abstract Only

We have previously detected VZV in healthy astronauts both during spaceflight and shortly after landing. Herein, we show that VZV shed in seropositive astronauts is infectious. A total of 40 saliva samples were obtained from each of the 3 astronauts. From each astronaut, 14 samples were taken 109 to 133 days before liftoff, 1 sample was taken every day during 12 days in space, and one sample was taken for 14 consecutive days beginning the second day after landing. Quantitative PCR was used to detect VZV DNA in saliva. None of 42 preflight saliva samples contained VZV DNA. VZV DNA was detected in saliva from 2 of 3 astronauts. In 1 astronaut, 6 of 12 samples obtained during space flight contained 120 to 2,500 copies of VZV DNA per ml; after landing, 1250 copies of VZV DNA were present on day 2, 45 copies on day 3, and 110 copies on day 5. All samples taken 6 to 15 days after touchdown were negative for VZV DNA. In the second astronaut, 5 of 12 samples obtained during space flight contained 18 to 650 copies of VZV DNA per ml; after landing, 560 copies of VZV DNA were present in saliva on day 2, 340 copies on day 4, 45 copies on day 5, and 23 copies on day 6. All samples taken 7 to 15 days after touchdown were negative for VZV DNA. Saliva taken 2 to 6 days after landing from all 3 astronauts was cultured on human fetal lung cells. After one subcultivation, a cytopathic effect developed in cultures inoculated with saliva from the two astronauts whose saliva contained VZV DNA. Both PCR and immunostaining identified the isolates to be VZV and not HSV-1. Importantly, the astronaut in whom no VZV was detected had a history of zoster 9 years earlier. It is possible that a boost in cell-mediated immunity to VZV which is known to develop after zoster protected him from subclinical reactivation. The genotype of the two VZV isolates was determined by VZV ORF22-based PCR/sequencing along with FRET-based PCR assays that target specific nucleotide polymorphisms. Both VZV isolates were found to be the European genotype which also contained a rare MspI restriction endonuclease site in VZV ORF62 at position 107,252. These findings extend our previous demonstration of VZV DNA in saliva of astronauts by showing that infectious VZV is also present. Thus, like HSV-1 and HSV-2, VZV can reactivate and shed infectious virus in the absence of clinical disease.

Author

*Astronauts; Infectious Diseases; Saliva; Space Flight; Viral Diseases; Viruses*

**20070014487** Marquette Univ., Milwaukee, WI, USA

**Effect of Prolonged Space Flight on Human Skeletal Muscle (BIOPSY)**

Fitts, Robert; International Space Station Research Summary Through Expedition 10; September 2006, pp. 7-8; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

It is well established that space flight can result in loss of skeletal muscle mass and strength. This atrophy continues throughout a crew's mission, even if crewmembers adhere to a strict exercise regime. What researchers do not understand, however, are the effects that prolonged stays in microgravity have on skeletal muscles. Biopsy will evaluate changes in calf

muscle function over long-duration space flights (30 to 180 days). In Biopsy, a specially designed torque velocity dynamometer is used to measure muscle strength before and after flight. Biopsies are also taken from the soleus and gastrocnemius muscles of participants. This allows determination of the cell size and the structural properties of individual fast and slow muscle fibers. Chemical analysis of the biopsies determines muscle fiber structural changes involving myosin, a protein ‘molecular motor’ that drives muscle contractions and cell divisions, enzymes, and substrates. Electron microscopy determines the relationship between thick and thin filament, the amount of myofilament loss, and changes in membrane-associated protein complexes found in skeletal muscle fibers and connective tissue that help the muscle resist stretch-induced damage.

Author

*Musculoskeletal System; Skeletal Muscle; Muscular Function; Microgravity; Long Duration Space Flight; Connective Tissue; Atrophy; Proteins; Muscle Fibers*

**20070014488** BioServe Space Technologies, Boulder, CO, USA

**Commercial Biomedical Testing Module (CBTM): Effects of Osteoprotegerin (OPG) on Bone Maintenance in Microgravity**

Bateman, Ted; International Space Station Research Summary Through Expedition 10; September 2006, pp. 9-10; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Osteoporosis is a debilitating disease that afflicts millions worldwide. One of the physiological changes experienced by space crews during space flight is the accelerated loss of bone mass due to the lack of gravitational loading on the skeleton, a loss that is similar to that experienced by the elderly population on Earth. Osteoprotegerin (OPG), which is a bone metabolism regulator, is being evaluated by the Food and Drug Administration (FDA) as a new treatment for osteoporosis. The Commercial Biomedical Testing Module (CBTM) examined the effects of OPG on bone maintenance in space using aged mice (older than nine months) as test subjects. The bone changes observed in older mice more closely reflect the bone changes observed in older humans. The mice were housed in three animal enclosure modules (AEMs), which provide the animal subjects with everything necessary to maintain health. Half of the mice were treated with OPG, a novel protein that regulates bone resorption, and half were treated with a placebo.

Author

*Bone Demineralization; Microgravity; Osteoporosis; Diseases; Musculoskeletal System; Metabolism*

**20070014500** NASA Johnson Space Center, Houston, TX, USA

**Organ Dose Measurement Using a Phantom Torso (TORSO)**

Badhwar, Gautam D.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 34; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The most critical risk to humans in space is radiation exposure (see <http://bioastroroadmap.nasa.gov/index.jsp>, NASA’s Bioastronautics Roadmap, for a ranked list of risks and countermeasures). Outside the protection of Earth’s atmosphere, space crews are exposed to a wide range of particles, including neutrons, that are not normally a threat on Earth. Exposure to radiation found in low Earth orbit and beyond can cause cataracts, cancer, damage to reproductive organs and the nervous system, and changes in heredity. Three experiments, BBND, DOSMAP, and Torso, flew on station in 2001 to measure the type and dose levels of radiation penetrating the station’s interior. Torso was unique because, by mimicking the human body, it allowed researchers to measure the radiation dose received by the crew, not just inside the station. Torso is a plastic equivalent anatomical model of a male head and torso composed of a Nomex ‘skin.’ It contains passive dosimeters in more than 350 locations throughout five layers. Five small active dosimeters (SMADOS) are located in the head, neck, heart, stomach, and colon regions. A common battery, located in Torso’s abdomen pocket, powers the SMADOS. The SMADOS measure absorbed dose and dose-equivalent, and the returned data are calculated based on the duration of the measurements. The tissue equivalent proportional counter (TEPC) consists of a spectrometer and cylindrical detector with which to measure external radiation doses. The TEPC is a microdosimetric instrument that measures radiation dose and dose equivalent in complex radiation fields (fields containing a mixture of particle types). The charged particle directional spectrometer (CPDS) measures particle energy and direction inside ISS. Both the TEPC and the CPDS remained within 1-1.5 feet (30.48-45.72 cm) of Torso during its operation on station.

Author

*Dosage; Organs; Radiation Dosage; Radiation Distribution; Risk; Spacecrews; Torso; Bioastronautics*



**20070014503** Kayser Italia, Livorno, Italy

**Hand Posture Analyzer (HPA)**

Zolesi, Valfredo; International Space Station Research Summary Through Expedition 10; September 2006, pp. 14; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Hand Posture Analyzer (HPA) examines the way hand and arm muscles are used differently during grasping and reaching tasks in weightlessness. Measurements are compared to those taken both before and after flight. In this way, the HPA study will lead to a better understanding of the effects of long-duration space flight on muscle fatigue.

Author

*Weightlessness; Posture; Muscles; Hand (Anatomy); Analyzing*

**20070014513** NASA Johnson Space Center, Houston, TX, USA

**Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate Locomotor Dysfunction After Long-duration Space Flight (MOBILITY)**

Bloomberg, Jacob; International Space Station Research Summary Through Expedition 10; September 2006, pp. 22; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Following space flight, astronauts experience disturbances in balance and walking control during the postflight readaptation period, due in part to changes in the way the central nervous system processes sensory information as a result of prolonged exposure to microgravity. The goal of this study is to develop an in-flight treadmill training program that facilitates recovery of locomotor function after long-duration space flight. The proposed training program is based on the concept of adaptive generalization. During this type of training, the subject gains experience producing the appropriate adaptive behavior under a variety of sensory conditions and balance challenges. As a result of this training, the subject learns to solve a class of balance and walking problems rather than producing a single solution to one problem. Therefore, the subject gains the ability to 'learn to learn' under a variety of conditions that challenge the balance and walking control systems. This study will develop an in-flight countermeasure built around ISS treadmill exercise activities. By manipulating the sensory conditions of exercise (e.g., varying visual flow patterns during walking), this training regimen will systematically and repeatedly promote adaptive change in walking performance, improving the ability of the astronaut to adapt to a novel gravity environment. It is anticipated that this training regimen will facilitate neural adaptation to unit (Earth) and partial (Mars) gravity after long-duration space flight. The Mobility protocol is performed by two sets of ISS subjects comprising control and experimental groups. All participating subjects (control and experimental) perform two tests of locomotor performance both preflight and postflight: the Integrated Treadmill Locomotion Test and the Functional Mobility Test. The experimental group will also perform the inflight training protocol throughout the Expedition. Comparisons will then be made between recovery rates in the control vs. experimental groups.

Author

*Locomotion; Central Nervous System; Physical Exercise; Microgravity; Adaptation; Astronauts; Countermeasures; Mobility*

**20070014518** Cleveland Clinic Foundation, Cleveland, OH, USA

**Foot/Ground Reaction Forces During Space Flight (FOOT)**

Cavanagh, Peter R.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 11; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The human body is designed to bear weight. Without the stimulation caused by placing weight on lower extremities, whether due to the microgravity environment or lack of use on Earth, bone will lose mass and muscles will lose strength. The Foot experiment characterizes the load placed on lower extremities during daily activities on station and examines to what degree mechanical load stimulus, via an in-flight exercise routine, could prevent the muscle atrophy and bone loss associated with space flight. To achieve this, Foot has several sensors mounted in a special pair of Lycra exercise pants, the lower extremity monitoring suit (LEMS). The total force-foot ground interface (TF-FGI) serves as an insole that, when placed inside a shoe, measures the amount of force placed on the bottom of the foot. Joint excursion sensors (JESs) record joint angles at the ankle, knee, and hip. Electromyography (EMG) electrodes record muscle activity, including net neural drive, along the leg (the vastus medialis, rectus femoris, biceps femoris, gastrocnemius, and tibial anterior) and in the right arm (the biceps brachii and triceps brachii). Information is collected by an ambulatory data acquisition system and downloaded into the Human Research Facility (HRF) laptop on board ISS after each session.

Author

*Activity (Biology); Human Body; Data Acquisition; Electromyography; Loads (Forces); Microgravity; Physical Exercise; Muscular Function; Leg (Anatomy)*

**20070014519** McGill Univ., Montreal, Quebec, Canada

**Effects of Altered Gravity on Spinal Cord Excitability (H-REFLEX)**

Watt, Douglas; International Space Station Research Summary Through Expedition 10; September 2006, pp. 12-13; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

In the weightlessness of low Earth orbit, the body loses muscle mass and bone density. The only known countermeasure for this atrophy is exercise. However, as astronauts spend longer durations in space, will exercise continue to be an effective countermeasure? Along with changes in muscle and bone, the neurovestibular system (the complex sensory system that maintains posture, balance, and coordination) adapts to changes in gravity. Researchers hypothesize that, as part of this neurovestibular system adaptation, spinal cord excitability decreases and the spinal cord reacts less to stimuli. If this hypothesis is correct, exercise may become less effective the longer astronauts stay in microgravity, and researchers may have to adjust exercise programs accordingly. H-Reflex tested this hypothesis by measuring muscle response to mild electrical shocks (40-90 volts). Nerves in the leg perceive the electrical shock and send a signal along the spinal cord to the brain. The signal stimulates motoneurons in the brain, which, in turn, send signals that cause leg muscles to contract. The bigger the contraction, the more the neurons are stimulated, indicating the level of spinal cord excitability. Researchers compared measurements taken before, during, and after flight to determine whether the spinal cord's ability to respond to stimuli changed over time. The H-Reflex equipment recorded the EMG activity in the muscle, the electrical activity that caused the muscle to move, rather than the movement that follows the electrical activity (as a knee-tap test would), allowing researchers to take more precise measurements.

Author

*Activity (Biology); Weightlessness; Spinal Cord; Reflexes; Muscular Function; Gravitational Effects; Electromyography; Nerves; Microgravity*

**20070014542** Thomson and Nielsen Electronics, Ottawa, Ontario, Canada

**A Study of Radiation Doses Experienced by Astronauts in EVA (EVARM)**

Thomson, Ian; International Space Station Research Summary Through Expedition 10; September 2006, pp. 33; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Extravehicular mobility units (EMUs, or spacesuits), which are worn by spacewalking astronauts, provide less shielding from radiation than the spacecraft. This means that spacewalkers are exposed to higher radiation levels during EVAs than at other times on orbit. When planning EVAs, teams take into account mission parameters, estimated duration, and ISS altitude and inclination and information on space weather conditions (e.g., solar activity, geomagnetic field conditions, proton flux) anticipated for that day. In addition to specific lifetime radiation limits, medical standards specify that radiation doses achieved by astronauts should be as low as reasonably achievable (ALARA). To create new and improved shielding for EVAs, researchers must know the type and flux of radiation inside the EMU. The EVA Radiation Monitoring (EVARM) study investigated the dose received by different parts of the body (skin, eyes, blood-forming organs) during an EVA by measuring dose rate, based on the time and position of EVAs as compared to the orbit, altitude, and attitude of the ISS.

Derived from text

*Extravehicular Mobility Units; Radiation Dosage; Radiation Measurement; Biological Effects; Radiation Effects*

**20070014543** Essen Univ., Germany

**Chromosomal Aberrations in Blood Lymphocytes of Astronauts (CHROMOSOME)**

Obe, Guenter; Horstmann, Markus; Johannes, Christian; Goedecke, Wolfgang; International Space Station Research Summary Through Expedition 10; September 2006, pp. 31; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Crewmembers are exposed to radiation when they leave the protection of Earth's atmosphere. Ionizing radiation in particular can damage chromosomes, causing mutations such as chromosome aberrations. To assess the genetic impact of this radiation, blood is drawn before and immediately after flight by venous puncture. The blood is then cultured and the lymphocytes are stimulated to undergo mitosis (the process of cell division). In the first mitosis, at about 48 hours of incubation, the process is stopped and the chromosomes are prepared and stained using three different methods of microscopic analysis to assess all types of aberrations induced by ionizing radiations. These methods are: 1. Classic Giesma staining, which allows the researcher to investigate changes in the morphology of the chromosomes. Chromosomes have a natural x-shape. Structural changes detected using Giesma include dicentric (the two chromatids of each chromosome are attached twice) and ring chromosomes or fragments (chromosome pieces without a centromere). 2. Multicolor Fluorescence In-Situ Hybridization (mFISH), which scores reciprocal translocations and insertions (exchange of parts between different chromosomes). 3. Multicolor Banding Fluorescence In-Situ Hybridization (mBAND) of the selected chromosome pair 5, which scores for

inversions and translocations between homologous chromosomes (exchange or relocation of deoxyribonucleic acid (DNA) parts within the same chromosome pair). A quantitative comparison between preflight and postflight aberration values will give information about the chromosome-breaking effects of cosmic radiation in blood lymphocytes of space travelers. Information will be generated concerning the participation of each chromosome pair in aberration formation as well as the inter- and intrachromosomal distribution of different aberration types. The association of chromosomal aberrations with an enhanced cancer risk stresses the importance of the planned research.

Derived from text

*Chromosome Aberrations; Chromosomes; Deoxyribonucleic Acid; Mutations; Radiation Effects; Biological Effects; Physiological Effects*

**20070014548** NASA Johnson Space Center, Houston, TX, USA

**Renal Stone Risk During Space Flight: Assessment and Countermeasure Validation (RENAL STONE)**

Whitson, Peggy A.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 15; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The loss of calcium from bone combined with decreased fluid intake in flight increases the probability for kidney stone formation during and after flight. Development of a kidney (or renal) stone in an astronaut can have serious consequences since it cannot be treated in flight as it would be on the ground. Therefore, quantification of renal stone formation potential and recovery is necessary to reduce this risk. This study studies the potential development of renal stones in space crews and the efficacy of a pharmaceutical countermeasure. Potassium citrate (K-cit) is a proven ground-based treatment for patients suffering from renal stones. In this study, from three days before launch and continuing through 14 days after landing each crewmember takes either two K-cit tablets or two placebos daily. They collect urine samples during 24-hour periods when in flight, once at the beginning, midway point, and end of a mission. In addition to taking pills and collecting urine samples, crewmembers maintain handwritten logs of their daily food and fluid intake, exercise, and medication during the time of the urine collections. These log books act as a backup to the barcode reader records that are part of the inventory management system with which crews typically record food intake and medication. Ultimately, these data will not only help long-duration space flight crews but also will aid those on Earth in understanding how renal stones form in otherwise healthy persons. This should also provide insight into stoneforming diseases on Earth.

Author

*Kidney Stones; Bones; Pharmacology; Countermeasures; Diseases*

**20070014549** NASA Johnson Space Center, Houston, TX, USA

**Postflight Orthostatic Hypotension (MIDODRINE)**

Meck, Janice; International Space Station Research Summary Through Expedition 10; September 2006, pp. 21; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Many astronauts experience postflight orthostatic hypotension, a condition where the blood pressure drops when an individual stands up, resulting in presyncope (lightheadedness) or syncope (fainting). Approximately 20% of crews on short-duration missions and 83% of crews on longer-duration missions experience some degree of orthostatic intolerance after return to Earth. To date, the countermeasures tested, such as fluid loading, the use of lower body negative pressure (LBNP), and Fluronef, have not successfully eliminated postflight orthostatic hypotension. On Earth, the drug Midodrine has been used extensively to treat low blood pressure. This investigation studies the effectiveness of Midodrine for the treatment of postflight orthostatic hypotension (dizziness or faintness following space flight). Midodrine has been previously tested as a pharmaceutical countermeasure by shuttle crewmembers. This experiment is the first test of the effectiveness of Midodrine following longer-duration flights.

Author

*Hypotension; Physiological Effects; Astronauts; Blood Pressure; Lower Body Negative Pressure; Spacecrews; Countermeasures*

**20070014550** Danish Aerospace Medical Center of Research, Copenhagen, Denmark

**Test of Midodrine as a Countermeasure Against Effect of Microgravity on the Peripheral Subcutaneous Venous-arteriolar Reflex in Humans (XENON-1)**

Gabrielsen, Anders; International Space Station Research Summary Through Expedition 10; September 2006, pp. 24; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

When we lower our legs in relationship to our heart, the body triggers what is called a local veno-arteriolar reflex, where

small subcutaneous (below the surface of the skin) blood vessels constrict, forcing blood from our feet toward our head. If this reflex is not properly triggered or if blood circulation is impeded, the blood pressure drops, causing dizziness and, possibly, fainting. This effect is called orthostatic intolerance. Due to a number of possible reasons, reduced fluid volume, muscle atrophy, neurovestibular adaptation, astronauts suffer from orthostatic intolerance during entry and landing, and for a few days postflight, interfering with their ability to perform entry and landing tasks and prolonging their recovery period. Xenon-1 will test the local veno-arteriolar reflex in an effort to understand the source of, and ways to combat, postflight orthostatic intolerance. Prior to and following Expeditions 3, 4, and 5, station crewmembers were placed on a gurney as a small amount of Xenon-133, a radioactive isotope dissolved in sterile saline solution, was injected into the subcutaneous tissue of their lower legs. Arterial blood pressure was recorded by a continuous pressure device on the crewmember's index finger. This measurement, which was taken with the Xenon-1 detector unit, was used to trace the movement of the Xenon tracer following injection. As the measurements were taken, the Xenon memory box recorded and displayed the counting rate.

Author

*Gravitational Effects; Blood Vessels; Blood Circulation; Physiological Effects; Countermeasures; Blood Pressure; Actuators; Arteries*

## 54

### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

**20070014076** Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Soesterberg, Netherlands

#### **Loss of Military Performance due to Individual NBC Protection in a Tropic Environment**

Reffeltrath, P. A.; Tan, T. K.; August 2006; 6 pp.; In English

Contract(s)/Grant(s): TNO Proj. 013.42343

Report No.(s): TNO-DV3-2006-A060; TD2005-0520; Copyright; Avail.: Other Sources

To obtain more knowledge about working in the field under NBC protection a field experiment was performed in a tropical climate. This was performed during field trials of the project 'protection factor in the field', which was performed within the framework of the Anglo Netherlands Norwegian Cooperation on Chemical Protection (ANNCP). These trials were conducted in Curacao on the Netherlands Antilles. In the course of the study measurements were performed on the physiology and performance of Dutch Marines in NBC protective clothing. Wearing a respirator during a speed-march result in an increased heart rate, a rise in core temperature and a reduction in speed. Wearing full NBC protection can result in a reduction of more than 30% in manual dexterity tasks. No relation was observed between the environmental temperature and the perceived comfort, thermal comfort or exertion when wearing full NBC protection. Wearing this equipment did not result in changes in the mood of the soldiers. It was concluded that using NBC protective clothing in a tropic environment is a heavy physiologic burden for soldiers. This can lead to measurable loss of military performance in the field. The effects on perceived strain and mood of the soldiers are less clear.

Author

*Human Performance; Physical Work; Protective Clothing; Thermal Comfort; Tropical Regions; Safety Devices*

## 55

### EXO BIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

**20070014525** Arizona State Univ., Tempe, AZ, USA

#### **Yeast-Group Activation Packs (YEAST-GAP)**

Nickerson, Cheryl A.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 74; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

This experiment was designed to study how individual genes respond to microgravity conditions. To achieve this, scientists studied yeast cells, eukaryotic cells, or cells that contain a distinct nucleus bound by a cell membrane. Mammalian cells have a similar eukaryotic structure, and the results of this experiment could aid in understanding more complex mammalian cell response to microgravity. Yeast cells are far simpler than mammalian cells because they have a

well-characterized, much smaller genome. This makes it easier for scientists to study how microgravity alters the makeup of the cells and their potential function. Yeast is an ideal candidate for such a study because it is hardy enough to resist the rigors of flight, requires no refrigeration, and poses little risk to ISS crewmembers. The experiment used genetically engineered cells of brewer's yeast (*Saccharomyces cerevisiae*) and a special cell growth chamber called a group activation pack (GAP) developed by BioServe Space Technologies. The goal is to identify the precise genes of yeast that are affected by growth in microgravity to understand differences in the growth of yeast cells in space and on Earth.

Author

*Genes; Microgravity; Physiological Responses; Cells (Biology); Eukaryotes; Saccharomyces; Yeast; Cell Division*

## 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*.

**20070013758** Wake Forest Univ., Winston-Salem, NC, USA

#### **Method, Systems, and Computer Program Products for Implementing Function-Parallel Network Firewall**

Fulp, E. W.; Farley, R. J.; 22 Dec 05; 41 pp.; In English

Contract(s)/Grant(s): DE-FG02-03ER25581

Patent Info.: Filed 22 Dec 05; US-Patent-Appl-SN-11-316-331

Report No.(s): PB2007-101673; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Methods, systems, and computer program products for providing function-parallel firewalls are disclosed. According to one aspect, a function-parallel firewall includes a first firewall node for filtering received packets using a first portion of a rule set including a plurality of rules. The first portion includes less than all of the rules in the rule set. At least one second firewall node filters packets using a second portion of the rule set. The second portion includes at least one rule in the rule set that is not present in the first portion. The first and second portions together include all of the rules in the rule set.

NTIS

*Computer Programs; Data Processing; Parallel Processing (Computers); Patent Applications*

**20070013760** Cave (Bryan), LLP, Saint Louis, MO, USA

#### **Intelligent Consequence Management System**

Gattuso, J. A.; Clayton, T.; 1 Apr 04; 20 pp.; In English

Contract(s)/Grant(s): SBIR-N00178-03-C-3047; SBIR-N00178-04-C-3054

Patent Info.: Filed 1 Apr 04; US-Patent-Appl-SN-10-815-569

Report No.(s): PB2007-105922; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A method to selectively disseminate information in a distributed computer system of the type having a plurality of originating and target nodes. A publisher is associated with an originating node and is authorized to provide an informational message defined by a set of attributes to the system. A subscriber is associated with a target node and is authorized to receive information from the system. Each subscriber may establish a set of content filters to identify the attributes of informational messages of interest to such subscriber. The informational messages may then be screened to determine the subscribers that should receive the informational message based on the subscriber's content filters. In order to transfer the published informational message from the originating node associated with the publisher to the target nodes associated with all subscribers determined to receive the message, a description of the first informational message is transmitted to the target nodes associated with such subscribers. The description is reviewed to determine if the target node already contains the informational message and such determination is provided back to the originating node. In this fashion, the informational message is only transferred to the target nodes associated with those subscribers requiring the informational message.

NTIS

*Management Systems; Patent Applications*



**20070013761** Fish and Richardson, San Diego, CA, USA

**Detecting Public Network Attacks Using Signatures and Fast Content Analysis**

Singh, S.; Varghese, G.; Estan, C.; Savage, S.; 8 Apr 04; 23 pp.; In English

Contract(s)/Grant(s): NIST-60NANB1D0118; NSF-ANI-0137102

Patent Info.: Filed Filed 8 Apr 04; US-Patent-Appl-SN-10-822-226

Report No.(s): PB2007-105921; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Detecting attacks against computer systems by automatically detecting signatures based on predetermined characteristics of the intrusion. One aspect looks for commonalities among a number of different network messages, and establishes an intrusion signature based on those commonalities. Data reduction techniques, such as a hash function, are used to minimize the amount of resources which are necessary to establish the commonalities. In an embodiment, signatures are created based on the data reduction hash technique. Frequent signatures are found by reducing the signatures using that hash technique. Each of the frequent signatures is analyzed for content, and content which is spreading is flagged as being a possible attack. Additional checks can also be carried out to look for code within the signal, to look for spam, backdoors, or program code.

NTIS

*Detection; Patent Applications; Signatures*

**20070013805** Alston and Bird, LLP, Charlotte, NC, USA

**Adaptive Observer and Related Method**

Hovakimyan, N.; Anthony, C.; Madyastha, V.; 8 Oct 04; 18 pp.; In English

Contract(s)/Grant(s): AFOSR-F49620-01-1-0024

Patent Info.: Filed Filed 8 Oct 04; US-Patent-Appl-SN-10-961 883

Report No.(s): PB2007-103149; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A disclosed apparatus comprises an adaptive observer that has an adaptive element to augment a linear observer to enhance its ability to control a nonlinear system. The adaptive element comprises a first, and optionally a second, nonlinearly parameterized neural network unit, the inputs and output layer weights of which can be adapted on line. The adaptive observer generates the neural network units' teaching signal by an additional linear error observer of the nominal system's error dynamics. The adaptive observer has the ability to track an observed system in the presence of unmodeled dynamics and disturbances. The adaptive observer comprises a delay element incorporated in the adaptive element in order to provide delayed values of an actual output signal and a control signal to the neural network units.

NTIS

*Automatic Control; Tracking (Position); Adaptive Control*

**20070013937** Sandia National Labs., Albuquerque, NM USA, Sandia National Labs., Livermore, CA, USA

**Dakota, A Multilevel Parallel Object-Oriented Framework for Design Optimization, Parameter Estimation, Uncertainty Quantification, and Sensitivity Analysis. Version 4.0 User's Manual**

Eldred, M. S.; Brown, S. L.; Adams, B. M.; Dunlavy, D. M.; Gay, D. M.; Oct. 2006; 292 pp.; In English

Report No.(s): DE2006-895703; SAND2006-6337; No Copyright; Avail.: National Technical Information Service (NTIS)

The DAKOTA (Design Analysis Kit for Optimization and Terascale Applications) toolkit provides a flexible and extensible interface between simulation codes and iterative analysis methods. DAKOTA contains algorithms for optimization with gradient and nongradient-based methods; uncertainty quantification with sampling, reliability, and stochastic finite element methods; parameter estimation with nonlinear least squares methods; and sensitivity/variance analysis with design of experiments and parameter study methods. These capabilities may be used on their own or as components within advanced strategies such as surrogate-based optimization, mixed integer nonlinear programming, or optimization under uncertainty. By employing object-oriented design to implement abstractions of the key components required for iterative systems analyses, the DAKOTA toolkit provides a flexible and extensible problem-solving environment for design and performance analysis of computational models on high performance computers. This report serves as a user's manual for the DAKOTA software and provides capability overviews and procedures for software execution, as well as a variety of example studies.

NTIS

*Design Analysis; Design Optimization; Object-Oriented Programming; Parameter Identification; Sensitivity Analysis; User Manuals (Computer Programs)*

**20070014004** Old Dominion Univ., Norfolk, VA, USA

**On the Stability of Jump-Linear Systems Driven by Finite-State Machines with Markovian Inputs**

Patilkulkarni, Sudarshan; Herencia-Zapana, Heber; Gray, W. Steven; Gonzalez, Oscar R.; July 02, 2004; 6 pp.; In English; 2004 American Control Conference, 30 Jun. - 2 Jul. 2005, Boston, MA, USA

Contract(s)/Grant(s): NCC1-392; NCC1-03026; NSF CCR-0209094; Copyright; Avail.: Other Sources

This paper presents two mean-square stability tests for a jump-linear system driven by a finite-state machine with a first-order Markovian input process. The first test is based on conventional Markov jump-linear theory and avoids the use of any higher-order statistics. The second test is developed directly using the higher-order statistics of the machine's output process. The two approaches are illustrated with a simple model for a recoverable computer control system.

Author

*Numerical Control; Statistical Analysis; Linear Systems; Mean Square Values; Stability Tests*

**20070014005** Old Dominion Univ., Norfolk, VA, USA

**Stochastic Stability of Nonlinear Sampled Data Systems with a Jump Linear Controller**

Gonzalez, Oscar R.; Herencia-Zapana, Heber; Gray, W. Steven; December 17, 2004; 6 pp.; In English; 43rd IEEE Conference on Decision and Control, 14-17 Dec. 2004, Atlantis, Bahamas

Contract(s)/Grant(s): NCC1-03026; NNL04AA03A; NSF CCR-0209094

Report No.(s): FrA01.2; Copyright; Avail.: Other Sources

This paper analyzes the stability of a sampled-data system consisting of a deterministic, nonlinear, time-invariant, continuous-time plant and a stochastic, discrete-time, jump linear controller. The jump linear controller models, for example, computer systems and communication networks that are subject to stochastic upsets or disruptions. This sampled-data model has been used in the analysis and design of fault-tolerant systems and computer-control systems with random communication delays without taking into account the inter-sample response. To analyze stability, appropriate topologies are introduced for the signal spaces of the sampled-data system. With these topologies, the ideal sampling and zero-order-hold operators are shown to be measurable maps. This paper shows that the known equivalence between the stability of a deterministic, linear sampled-data system and its associated discrete-time representation as well as between a nonlinear sampled-data system and a linearized representation holds even in a stochastic framework.

Author

*Numerical Control; Nonlinear Systems; Stochastic Processes; Sampled Data Systems; Fault Tolerance; Stability*

**20070014014** Old Dominion Univ., Norfolk, VA, USA

**Towards Stability Analysis of Jump Linear Systems with State-Dependent and Stochastic Switching**

Tejada, Arturo; Gonzalez, Oscar R.; Gray, W. Steven; July 02, 2004; 6 pp.; In English; American Control Conference, 30 Jun. - 2 Jul. 2004, Boston, MA, USA

Contract(s)/Grant(s): NCC1-392; NCC1-03026; NSF CCR-0209094

Report No.(s): WeP17.6; Copyright; Avail.: Other Sources

This paper analyzes the stability of hierarchical jump linear systems where the supervisor is driven by a Markovian stochastic process and by the values of the supervised jump linear system's states. The stability framework for this class of systems is developed over infinite and finite time horizons. The framework is then used to derive sufficient stability conditions for a specific class of hybrid jump linear systems with performance supervision. New sufficient stochastic stability conditions for discrete-time jump linear systems are also presented.

Author

*Stability Tests; Switching; Linear Systems*

**20070014588** Lawrence Livermore National Lab., Livermore, CA USA

**FY2006 Engineering Tech Base Report: Defect Detection in Large CT Image Sets**

Poland, D. N.; Lopez, A.; Manay, S.; Sengupta, S.; Sep. 18, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896596; UCRL-TR-224486; No Copyright; Avail.: Department of Energy Information Bridge

This image analysis project is constructing a tool for performing computer assisted detection of defects in large CT data sets. We address two primary challenges: proving an algorithm that can reliably highlight the objects of interest, and coupling this algorithm to efficient and effective data management and interface routines. The goal of this project is to create an end to end tool that will efficiently extract from large CT data sets a manageable set of candidate defects that highlights 100% of

the unambiguous (to a trained analyst) true defects and as many as possible of the ambiguous objects. Objective metrics for defect ambiguity are elusive given the ill defined nature of both the defects and their CT images (e.g., variations in size and contrast, defect/object density gradients). Therefore the true metric of success will be gaining the confidence of the Weapons Program NDE analysts in this tool, which will be a qualitative function of efficiency and accuracy. In consultation with Weapons Program NDE analysts voids it was decided to focus this initial effort on searching for small voids (order of tenths to tens of millimeters in extent). The program has produced a Tungsten ring with surrogate defects drilled into it that they use for studying the ability of their systems and analysts to detect this class of defects.

NTIS

*Computer Aided Tomography; Defects; Detection; Image Analysis; Nondestructive Tests*

**20070014682** Lawrence Livermore National Lab., Livermore, CA USA

**Report on New Capabilities for the Purple Development Environment**

Futral, W. S.; Gyllenhaal, J. C.; Wolfe, M. E.; Chambreau, C. M.; Dec. 12, 2006; 5 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896589; UCRL-TR-226785; No Copyright; Avail.: Department of Energy Information Bridge

This image analysis project is constructing a tool for performing computer assisted detection of defects in large CT data sets. We address two primary challenges: proving an algorithm that can reliably highlight the objects of interest, and coupling this algorithm to efficient and effective data management and interface routines. The goal of this project is to create an end to end tool that will efficiently extract from large CT data sets a manageable set of candidate defects that highlights 100% of the unambiguous (to a trained analyst) true defects and as many as possible of the ambiguous objects. Objective metrics for defect ambiguity are elusive given the ill defined nature of both the defects and their CT images (e.g., variations in size and contrast, defect/object density gradients). Therefore the true metric of success will be gaining the confidence of the Weapons Program NDE analysts in this tool, which will be a qualitative function of efficiency and accuracy. In consultation with Weapons Program NDE analysts voids it was decided to focus this initial effort on searching for small voids (order of tenths to tens of millimeters in extent). The program has produced a Tungsten ring with surrogate defects drilled into it that they use for studying the ability of their systems and analysts to detect this class of defects.

NTIS

*Computers; Data Management; Nuclear Weapons*

**20070014765** Sandia National Labs., Albuquerque, NM USA, Sandia National Labs., Livermore, CA, USA

**Dakota, A Multilevel Parallel Object-Oriented Framework for Design Optimization, Parameter Estimation, Uncertainty Quantification, and Sensitivity Analysis. Version 4.0 Developers manual**

Eldred, M. S.; Brown, S. L.; Giunta, A. A.; Hart, W. E.; Watson, J. P.; Oct. 2006; 584 pp.; In English

Report No.(s): DE2006-896280; SAND2006-4056; No Copyright; Avail.: Department of Energy Information Bridge

The DAKOTA (Design Analysis Kit for Optimization and Terascale Applications) toolkit provides a flexible and extensible interface between simulation codes and iterative analysis methods. DAKOTA contains algorithms for optimization with gradient and nongradient-based methods; uncertainty quantification with sampling, reliability, and stochastic finite element methods; parameter estimation with nonlinear least squares methods; and sensitivity/variance analysis with design of experiments and parameter study methods. These capabilities may be used on their own or as components within advanced strategies such as surrogate-based optimization, mixed integer nonlinear programming, or optimization under uncertainty. By employing object-oriented design to implement abstractions of the key components required for iterative systems analyses, the DAKOTA toolkit provides a flexible and extensible problem-solving environment for design and performance analysis of computational models on high performance computers. This report serves as a developers manual for the DAKOTA software and describes the DAKOTA class hierarchies and their interrelationships. It derives directly from annotation of the actual source code and provides detailed class documentation, including all member functions and attributes.

NTIS

*Design Analysis; Design Optimization; Kits; Object-Oriented Programming; Parameter Identification; Sensitivity Analysis*

**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.

**20070014501** Boeing Co., Houston, TX, USA

**Serial Network Flow Monitor (SNFM)**

Konkel, Carl; International Space Station Research Summary Through Expedition 10; September 2006, pp. 91; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: **A01**, Hardcopy

The Serial Network Flow Monitor (SNFM) is a commercial off-the-shelf (COTS) software package that monitors packet traffic through the payload Ethernet local area networks (LANs) on board station. The SNFM experiment characterized the network equivalent of data traffic jams on board ISS. The SNFM team targeted historical problem areas including the Space Acceleration Measurement System-II (SAMS-II) communication issues, data transmissions from ISS to the ground teams, and multiple users on the network at the same time. By looking at how various users interact with each other on the network, conflicts can be identified and work can begin on solutions.

Author

*Commercial Off-the-Shelf Products; Computer Programs; Local Area Networks; Payloads; Data Transmission; Acceleration Measurement; Ethernet; Applications Programs (Computers)*

**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.

**20070013767** Space and Naval Warfare Systems Center, San Diego, CA USA

**Integrating Multilevel Command and Control into a Service Oriented Architecture to Provide Cross Domain Capability**

Raney, Christopher J; Jun 2006; 29 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463317; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463317>

Information superiority, the capability to collect, process, and disseminate an uninterrupted flow of information, is the cornerstone of Command and Control (C2). With the increasing coalition and multinational aspects of warfare in the 21st century, we must extend key information to our allies and coalition partners to ensure shared information dominance. Traditional information sharing methods such as automated guards or a man-in-the-loop has well documented problems including data loss through the guards and operational picture integrity. A multilevel C2 system has been developed and deployed that allows a multinational integrated operational picture to be maintained and disseminated by US Intelligence Analysts. This system leverages the capability of a trusted operating system by storing all data in labeled files and using the operating system to enforce access control. This approach is difficult to extend to a service oriented architecture (SOA) because SOA infrastructures are large, complex entities that are not multilevel. In this paper, we address the issues associated with integrating an existing multilevel C2 system into a larger service oriented architecture. We present an architecture that can be generalized to integrate other MLS systems. We then propose a future architecture which addresses the limitations in the current system.

DTIC

*Command and Control; Architecture (Computers); Communication Networks*

**20070014068** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Requirements to Design to Code: Towards a Fully Formal Approach to Automatic Code Generation**

Hinchey, Michael G.; Rash, James L.; Rouff, Christopher A.; July 2005; 26 pp.; In English; Original contains black and white illustrations

Report No.(s): NASA/TM-2005-212774; Rept-2005-00861-0; Copyright; Avail.: CASI: **A03**, Hardcopy

A general-purpose method to mechanically transform system requirements into a provably equivalent model has yet to appear. Such a method represents a necessary step toward high-dependability system engineering for numerous possible application domains, including distributed software systems, sensor networks, robot operation, complex scripts for spacecraft

integration and testing, and autonomous systems. Currently available tools and methods that start with a formal model of a system and mechanically produce a provably equivalent implementation are valuable but not sufficient. The gap that current tools and methods leave unfilled is that their formal models cannot be proven to be equivalent to the system requirements as originated by the customer. For the classes of systems whose behavior can be described as a finite (but significant) set of scenarios, we offer a method for mechanically transforming requirements (expressed in restricted natural language, or in other appropriate graphical notations) into a provably equivalent formal model that can be used as the basis for code generation and other transformations.

Author

*Autonomy; Complex Systems; Computer Programs; Systems Engineering; Formalism; Mathematical Models*

**20070014480** Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk, Netherlands

**Report of POEMA-2 (Function Failure Analysis, Database, Electronics and Sealings)**

deKlerk, W. P. C.; Colpa, W.; Boers, M. N.; Hordijk, A. C.; Weijl, J. J. T. G.; December 2006; 10 pp.; In Danish

Contract(s)/Grant(s): A00KL400; TNO Proj. 014.15046

Report No.(s): TNO-DV-206-A477; TD2006-0156; Copyright; Avail.: Other Sources

Lifetime of ammunition is influenced by external conditions like the climate. Not only the energetic part of the article will be the critical one, also items as sealings or electronics could have a large impact on the safe and functional lifetime, To keep this information available, a database is set up which could act as a main input parameter for the function-failure-analysis (FFA).

Author

*Data Bases; Failure Analysis; Functional Analysis; Life (Durability); Reliability*

**20070014574** Lawrence Livermore National Lab., Livermore, CA USA

**Report on Challenges and Resolutions for the Purple Development Environment**

Futral, W. S.; Gyllenhaal, J. C.; Wolfe, M. E.; Chambreau, C. M.; Dec. 12, 2006; 5 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896590; UCRL-TR-226769; No Copyright; Avail.: Department of Energy Information Bridge

Previous AIX development environment experience with ASC White and Early Delivery systems UV and UM was leveraged to provide a smooth and robust transition to the Purple development environment. Still, there were three major changes that initially caused serious problems for Purple users. The first was making 64-bit builds of executables the default instead of 32-bit. The second was requiring all executables to use large page memory. The third was the phase-out of the popular, but now defunct, third-party C++ compiler KCC, which required the migration of many codes to IBM's x1C C++ compiler. On Purple, the default build environment changed from 32-bit builds to 64-bit builds in order to enable executables to use the 4GB per processor (32GB per node) memory available, and in order for the MPI library to do collective optimizations that required the larger 64-bit address space. The 64-bit build environment was made default by setting the IBM environment variable Object(-)mode to 64 and wrapping third-party software (mainly the gnu compilers) in order to make them handle Object(-)mode properly. Because not all applications could port to 64-bit right away, (usually due to third-party constraints, such as python not supporting 64-bit AIX builds until very recently), 32-bit builds of the major common third-party libraries also had to be supported. This combined 32/64 bit build support was accomplished fairly seamlessly using the AIX feature that allows both 32-bit and 64-bit versions of the code to appear in the same library file, and documentation with clear examples helped our library developers generate the required combined 32-bit and 64-bit libraries for Purple.

NTIS

*Computer Programs; Computer Systems Design; Software Development Tools; Operating Systems (Computers)*



**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*.

**20070013800** Browdy and Neimark, PLLC, Washington, DC, USA, New York Univ., NY, USA

**Nucleic Acid Based Nano-Robotic System**

Sherman, W. B.; Seeman, N. C.; 13 Oct 04; 94 pp.; In English

Contract(s)/Grant(s): NIH-GM-29554; ONR-N00014-98-1-0093

Patent Info.: Filed Filed 13 Oct 04; US-Patent-Appl-SN-10-962 995

Report No.(s): PB2007-103129; No Copyright; Avail.: CASI: [A05](#), Hardcopy

A multiped, capable of traveling in more than one direction along a molecular path in a nano-robotic system where the steps taken by the feet of the multiped are controlled in a sequence specific fashion, is presented. The feet of the multiped dock to footholds on the molecular path via cohesion with 'set' molecules and are released from the footholds through the introduction of 'unset' molecules that detach or strip away the 'set' molecules.

NTIS

*Deoxyribonucleic Acid; Nucleic Acids; Robotics; Sequencing; Nanotechnology*

**NUMERICAL ANALYSIS**

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

**20070014072** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Empirical Low Energy Ion Flux Model for the Terrestrial Magnetosphere**

Blackwell, William C.; Minow, Joseph I.; Diekmann, Anne M.; August 11, 2007; 25 pp.; In English; 45th Aerospace Science Meeting, 8-11 Jan. 2007, Reno, NV, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2007-1099; Copyright; Avail.: CASI: [A03](#), Hardcopy

This document is a viewgraph presentation. The Living With a Star Ion Flux Model (IFM) is a radiation environment risk mitigation tool that provides magnetospheric ion flux values for varying geomagnetic disturbance levels in the geospace environment. IFM incorporates flux observations from the Polar and Geotail spacecraft in a single statistical flux model. IFM is an engineering environment model which predicts the proton flux not only in the magnetosphere, but also in the solar wind and magnetosheath phenomenological regions. This paper describes the ion flux databases that allows for IFM output to be correlated with the geomagnetic activity level, as represented by the Kp index.

Author

*Flux (Rate); Geomagnetic Tail; Protons; Solar Wind; Models*

**STATISTICS AND PROBABILITY**

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

**20070013869** Florida Atlantic Univ., Boca Raton, FL, USA

**Econometric Analysis (I and II) of the Nurse-Patient Relationship**

Ray, M. A.; Sep. 1996; 143 pp.; In English

Contract(s)/Grant(s): N96-036; MDA 905-96-Z-0033

Report No.(s): PB2007-107642; Copyright; Avail.: National Technical Information Service (NTIS)

Increased accessibility to health care and managing costs within a managed care environment is the operational goal of military and civilian health care reform. The goal of administrators and health care providers is to provide cost-effective, high-quality care. The challenge to military and civilian nurses is the preservation of professional nursing practice in an era when outside forces are trying to change its scope and practice under the rubric of cost containment. Nurses must look to themselves to understand the issues facing the profession and discipline. Nurses must begin to understand the value of the nurse-patient relationship as an economic resource to patients, nurses, and administrators. This study was proposed for a

two-year period using a sample of military and civilian nurses, patients, and administrators. Its purpose was twofold.  
NTIS

*Econometrics; Health; Patients; Medical Personnel*

**20070013999** Old Dominion Univ., Norfolk, VA, USA

**Markovian Statistical Data Analysis of Single-Event Upsets Triggered by High Intensity Neutrons**

Lakdawala, Anushka V.; Zhang, Hong; Gonzalez, Oscar R.; Gray, W. Steven; 2006 Proceeding of the 38th Southeastern Symposium on System Theory; March 07, 2006, pp. 513-517; In English; 38th Southeastern Symposium on System Theory, 5-7 Mar. 2006, Cookeville, TN, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC1-03026; NNL04AA03A

Report No.(s): MC4.6; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/SSST.2006.1619136>

This paper analyzes data from a single-event upset experiment conducted at the Los Alamos National Laboratory. Statistical tools, based on well-known  $\chi^2$  hypothesis testing theory, are used to determine if sequences of upsets can be modeled as a homogeneous Markov chain of a specific order. The experiment consisted of radiating a new experimental flight control computer (FCC) with a high intensity neutron beam while the FCC controlled a simulation of a Boeing 737. The analyzed data is a sequence of states that indicates when the FCC is under an upset condition.

Author

*Neutrons; Single Event Upsets; Statistical Analysis; Markov Chains*

**20070014003** Old Dominion Univ., Norfolk, VA, USA

**Stochastic Stability of Sampled Data Systems with a Jump Linear Controller**

Gonzalez, Oscar R.; Herencia-Zapana, Heber; Gray, W. Steven; Proceedings of the 36th IEEE Southeastern Symposium on System Theory; March 16, 2004, pp. 256-260; In English; 36th IEEE Southeastern Symposium on System Theory, 14-16 Mar. 2004, Atlanta, GA, USA

Contract(s)/Grant(s): NCC1-392; NCC1-03026; NSF CCR-0209094

Report No.(s): 4C-5; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/SSST.2004.1295659>

In this paper an equivalence between the stochastic stability of a sampled-data system and its associated discrete-time representation is established. The sampled-data system consists of a deterministic, linear, time-invariant, continuous-time plant and a stochastic, linear, time-invariant, discrete-time, jump linear controller. The jump linear controller models computer systems and communication networks that are subject to stochastic upsets or disruptions. This sampled-data model has been used in the analysis and design of fault-tolerant systems and computer-control systems with random communication delays without taking into account the inter-sample response. This paper shows that the known equivalence between the stability of a deterministic sampled-data system and the associated discrete-time representation holds even in a stochastic framework.

Author

*Controllers; Linear Systems; Stability; Stochastic Processes; Sampled Data Systems; Mathematical Models; Discrete Functions*

66

**SYSTEMS ANALYSIS AND OPERATIONS RESEARCH**

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

**20070013769** Aptima, Inc., Woburn, MA USA

**Supporting Organizational Change in Command and Control: Approaches and Metrics**

Weil, Shawn A; Levchuk, Georgiy; Downes-Martin, Stephen; Diedrich, Frederick J; Entin, Elliot E; See, Katrina E; Serfaty, Daniel; Jun 2005; 52 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-02-C-0233

Report No.(s): AD-A463611; No Copyright; Avail.: CASI: A04, Hardcopy

Network-centered Command and Control (C2) has great potential to increase military effectiveness, in some measure due to enhanced information sharing and dissemination techniques. However, for these technologies to be maximally effective, C2 organizations need to have the flexibility to tailor their organizational structures in response to changing mission. In the experiment reported here, a model-based approach to supporting organizational adaptation was assessed. The purpose of this

experiment was to explore ways in which obstacles to adaptation could be overcome. Teams of Naval Officers participated in three simulations of a joint forces mission on the Distributed Dynamic Decision-making (DDD) simulator (Serfaty & Kleinman, 1985; Kleinman & Serfaty, 1989). The match between organizational structure and mission task requirements was manipulated within-participants, resulting in differences in coordination requirements. Between the second and third simulated missions, participant teams were given the opportunity to select an organizational structure from a list of model-based, predefined organizational designs, to better accommodate the changing mission requirements. To support organizational change, model-based prospective information was provided to the teams. This support led to the adoption of better matched congruent organizations in each of the participant teams. Several measurement techniques were designed to evaluate both the degree of adaptation and its effect on mission performance.

DTIC

*System Effectiveness; Communication Networks; Command and Control; Experiment Design*

**20070013894** NASA Langley Research Center, Hampton, VA, USA

**An Investigation of Synchrony in Transport Networks**

Kincaid, Rex K.; Alexandrov, Natalia M.; Holroyd, Michael J.; March 2007; 18 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNL05AA30G; WBS 984754.02.07.07

Report No.(s): NASA/TM-2007-214855; L-19323; Copyright; Avail.: CASI: [A03](#), Hardcopy

The cumulative degree distributions of transport networks, such as air transportation networks and respiratory neuronal networks, follow power laws. The significance of power laws with respect to other network performance measures, such as throughput and synchronization, remains an open question. Evolving methods for the analysis and design of air transportation networks must address network performance in the face of increasing demands and the need to contain and control local network disturbances, such as congestion. Toward this end, we investigate functional relationships that govern the performance of transport networks; for example, the links between the first nontrivial eigenvalue of a network's Laplacian matrix - a quantitative measure of network synchronizability - and other global network parameters. In particular, among networks with a fixed degree distribution and fixed network assortativity (a measure of a network's preference to attach nodes based on a similarity or difference), those with the small eigenvalue are shown to be poor synchronizers, to have much longer shortest paths and to have greater clustering in comparison to those with large. A simulation of a respiratory network adds data to our investigation. This study is a beginning step in developing metrics and design variables for the analysis and active design of air transport networks.

Author

*Air Transportation; Transportation Networks; Synchronism; Network Analysis; Air Traffic Control*

**20070014686** Sandia National Labs., Albuquerque, NM USA

**Development of a New Adaptive Ordinal Approach to Continuous-Variable Probabilistic Optimization**

Romero, J. V.; Chen, C. H.; Nov. 01, 2006; 38 pp.; In English

Contract(s)/Grant(s): AC04-94AL85000

Report No.(s): DE2006-896553; SAND-2006-5319; No Copyright; Avail.: National Technical Information Service (NTIS)

A very general and robust approach to solving continuous-variable optimization problems involving uncertainty in the objective function is through the use of ordinal optimization. At each step in the optimization problem, improvement is based only on a relative ranking of the uncertainty effects on local design alternatives, rather than on precise quantification of the effects. One simply asks 'Is that alternative better or worse than this one.' -not 'How much better or worse is that alternative to this one.' The answer to the latter question requires precise characterization of the uncertainty--with the corresponding sampling/integration expense for precise resolution. However, in this report we demonstrate correct decision-making in a continuous-variable probabilistic optimization problem despite extreme vagueness in the statistical characterization of the design options. We present a new adaptive ordinal method for probabilistic optimization in which the trade-off between computational expense and vagueness in the uncertainty characterization can be conveniently managed in various phases of the optimization problem to make cost-effective stepping decisions in the design space. Spatial correlation of uncertainty in the continuous-variable design space is exploited to dramatically increase method efficiency. Under many circumstances the method appears to have favorable robustness and cost-scaling properties relative to other probabilistic optimization methods, and uniquely has mechanisms for quantifying and controlling error likelihood in design-space stepping decisions. The method is asymptotically convergent to the true probabilistic optimum, so could be useful as a reference standard against which the

efficiency and robustness of other methods can be compared--analogous to the role that Monte Carlo simulation plays in uncertainty propagation.

NTIS

*Probability Theory; Optimization; Problem Solving*

## 67

### THEORETICAL MATHEMATICS

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

**20070013998** Old Dominion Univ., Norfolk, VA, USA

#### **A Measure-Theoretic Proof of the Markov Property for Hybrid Systems with Markovian Inputs**

Tejada, Arturo; Gonzalez, Oscar R.; Gray, W. Steven; Proceedings of the 38th Southeastern Symposium on System Theory; March 07, 2006, pp. 328-332; In English; 38th Southeastern Symposium on System Theory, 5-7 Mar. 2006, Cookeville, TN, USA

Contract(s)/Grant(s): NCC1-03026; NNL04AA03A; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/SSST.2006.1619071>

The behavior of a general hybrid system in discrete time can be represented by a non-linear difference equation  $x(k+1) = F_k(x(k), \theta(k))$ , where  $\theta(k)$  is assumed to be a finite state Markov chain. An important step in the stability analysis of these systems is to establish the Markov property of  $(x(k), \theta(k))$ . There are, however, no complete proofs of this property which are simple to understand. This paper aims to correct this problem by presenting a complete and explicit proof, which uses only basic measure-theoretical concepts.

Author

*Difference Equations; Markov Chains; Nonlinearity; Theorem Proving; Measure and Integration*

## 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*.

**20070013806** Morris Manning and Martin, LLP, Atlanta, GA, USA, Vanderbilt Univ., Nashville, TN, USA

#### **Compositions with Nano-particle Size Conductive Material Powder and Methods of using Same for Transferring Heat Between a Heat Source and a Heat Sink**

Davidson, J. L.; Bradshaw, D. T.; 7 Dec 04; 18 pp.; In English

Patent Info.: Filed Filed 7 Dec 04; US-Patent-Appl-SN-11-007 777

Report No.(s): PB2007-103281; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A heat transfer composition and methods for using same to transfer heat in a transformer. In one embodiment, a heat transfer composition has soy-based oil, an additive comprising a nano-particle size diamond powder characterized by a first mass, and a chemical agent characterized by a second mass, wherein the ratio of the second mass to the first mass is greater than one.

NTIS

*Heat Sinks; Heat Sources; Powder (Particles); Transformers; Working Fluids*

**20070013825** Stanford Linear Accelerator Center, CA, USA, Istituto Nazionale di Fisica Nucleare, Rome, Italy

#### **Experience with the Resistive Plate Chamber in the BABAR Experiment**

Beliini, F.; January 2006; 5 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895276; SLAC-PUB-12204; No Copyright; Avail.: Department of Energy Information Bridge

The BABAR detector has operated nearly 200 Resistive Plate Chambers (RPCs), constructed as part of an upgrade of the forward endcap muon detector, for the past two years. The RPCs experience widely different background and luminosity-driven singles rates (0.01-10 Hz/cm<sup>2</sup>) depending on position within the endcap. Some regions have integrated over 0.3 C/cm<sup>2</sup>. RPC efficiency measured with cosmic rays and beam is high and stable. However, a few of the highest rate RPCs

have suffered efficiency losses of 5-15%. Although constructed with improved techniques many of the RPCs, which are operated in streamer mode, have shown increased dark currents and noise rates that are correlated with the direction of the gas flow and the integrated current.

NTIS

*Cosmic Rays; Luminosity*

**20070013827** Banner and Witcoff, Washington, DC, USA, Saic Comsystem, San Diego, CA, USA

**Measuring Linear Separations in Digital Radiographs**

Polichar, R. M.; Rush, G. M.; Smith, S. T.; 7 May 04; 51 pp.; In English

Contract(s)/Grant(s): DAAE30-96-C-0013

Patent Info.: Filed 7 May 04; US-Patent-Appl-SN-10-840 652

Report No.(s): PB2007-103099; No Copyright; Avail.: CASI: [A04](#), Hardcopy

Digital pixel data is obtained from radiographic imaging of one or more objects, and corresponds to an imaged area containing a feature to be measured. A data profile for a region around the measured feature is created from the digital pixel data. A reference profile is then created from the data profile. The reference profile represents an expected data profile for a reference condition of the objects, and accounts for the point spread function of the imager. The difference between the data profile and the reference profile is calculated. Based on that difference, the degree by which the actual condition of the objects varies from the reference condition is determined. The calculated difference can be compared to a lookup table mapping previously calculated differences to degrees of variation from the reference condition. The calculated difference can also be used as an input to an experimentally derived formula.

NTIS

*Radiography; X Ray Detectors; Linearity; Pulse Communication*

**20070013831** Rice Univ., Houston, TX USA

**Nonlinear Dynamic Systems Response to Non-Stationary Excitation Using the Wavelet Transform. Report for January 1, 2003 to January 15, 2006**

Spanos, P. D.; January 2006; 6 pp.; In English

Contract(s)/Grant(s): DE-FG03-95 ER 14500

Report No.(s): DE2006-895300; No Copyright; Avail.: Department of Energy Information Bridge

The objective of this research project has been the development of techniques for estimating the power spectra of stochastic processes using wavelet transform, and the development of related techniques for determining the response of linear/nonlinear systems to excitations which are described via the wavelet transform. Both of the objectives have been achieved, and the research findings have been disseminated in papers in archival journals and technical conferences.

NTIS

*Dynamic Response; Power Spectra; Stochastic Processes; Wavelet Analysis*

**20070013838** Stanford Linear Accelerator Center, CA, USA, Ferrara Univ., Italy

**Barrel IFR Instrumented with Limited Streamer Tubes for BABAR Experiment**

Andreotti, M.; January 2006; 5 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895275; SLAC-PUB-12205; No Copyright; Avail.: Department of Energy Information Bridge

The new barrel Instrumented Flux Return (IFR) of BABAR detector will be reported here. Limited Streamer Tubes (LSTs) have been chosen to replace the existing RPCs as active elements of the barrel IFR. The layout of the new detector will be discussed: in particular, a cell bigger than the standard one has been used to improve efficiency and reliability. The extruded profile is coated with a resistive layer of graphite having a typical surface resistivity between 0.2 and 0.4 MOhm/square. The tubes are assembled in modules and installed in 12 active layers of each sextant of the IFR detector. R&D studies to choose the final design and Quality Control procedure adopted during the tube production will be briefly discussed. Finally the performances of installed LSTs into 2/3 of IFR after 8 months of operations will be reported.

NTIS

*Radiation Detectors; Electrical Resistivity; Graphite*

**20070013849** Brookhaven National Lab., Upton, NY, USA

**Recent References: April 1, 2006 to June 30, 2006**

Winchell, D. F.; Nov. 01, 2006; 112 pp.; In English

Report No.(s): DE2006-896454; BNL-77292-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge



This document lists experimental references added to Nuclear Science References (NSR) during the period April 1, 2006 to June 30, 2006. The first section lists keynumbers and keywords sorted by mass and nuclide. The second section lists all references, ordered by keynumber.

NTIS

*Data Bases; Nuclear Structure*

**20070013850** Brookhaven National Lab., Upton, NY, USA

**Recent References: July 1, 2006 to September 30, 2006**

Winchell, D. F.; Nov. 01, 2006; 116 pp.; In English

Report No.(s): DE2006-896455; BNL-77293-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge

This document lists experimental references added to Nuclear Science References (NSR) during the period July 1, 2006 to September 30, 2006. The first section lists keynumbers and keywords sorted by mass and nuclide. The second section lists all references, ordered by keynumber.

NTIS

*Data Bases; Nuclear Structure*

**20070013855** Centre National de la Recherche Scientifique, Nantes, France

**G0 Experiment at Jefferson Laboratory: The Nucleon Strangeness Form Factors**

Fuget, C.; Sep. 01, 2006; 6 pp.; In English

Report No.(s): DE2006-896483; JLAB-PHY-06-591; No Copyright; Avail.: Department of Energy Information Bridge

The  $G_0$  experiment is dedicated to the determination of the strange quark's contribution to the electric and magnetic nucleon form factors, provided by parity-violating asymmetries of cross-sections measured with longitudinally polarized electrons in elastic electron-proton scattering and quasi-elastic electron-deuteron scattering. Forward angle measurements, which have been performed in Hall C of Jefferson Laboratory, have provided a linear combination of electric and magnetic vector form factors for momentum transfers in the range 0.1 to 1 (GeV/c)<sup>2</sup>. Backward angle measurements, which will be performed starting in 2006, will allow the complete separation of the form factors at  $Q^2$  of 0.23 and 0.63 (GeV/c)<sup>2</sup>.

NTIS

*Asymmetry; Form Factors; Nucleons; Quarks; Strangeness*

**20070013876** Brookhaven National Lab., Upton, NY USA

**Recent References: January 1, 2005 to December 31, 2005**

Winchell, D. F.; Nov. 01, 2006; 481 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-896448; BNL-77286-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge

This document lists experimental references added to Nuclear Science References (NSR) during the period January 1, 2005 to December 31, 2005. The first section lists keynumbers and keywords sorted by mass and nuclide. The second section lists all references, ordered by keynumber.

NTIS

*Data Bases; Nuclear Structure*

**20070013906** Johns Hopkins Univ., Laurel, MD, USA

**Techniques for Quantum Processing with Photons and the Zeno Effect**

Franson, J. D.; Jacobs, B. C.; Pittman, T. B.; 29 Jun 04; 16 pp.; In English

Contract(s)/Grant(s): DAAD190210069

Patent Info.: Filed 29 Jun 04; US-Patent-Appl-SN-10-879 853

Report No.(s): PB2007-102444; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Techniques are provided that use the quantum Zeno effect to implement practical devices that use single photons as the qubits for quantum information processing. In the quantum Zeno effect, a randomly-occurring event is suppressed by frequent measurements to determine whether the event has occurred. The same results can be obtained by using atoms or molecules or ions to react to the occurrence of the event. Techniques include directing one or more input qubits onto a device and applying a quantum Zeno effect in the device. The quantum Zeno effect is applied by consuming one or more photons in the device under conditions in which photons, that would otherwise be output by the device, do not represent a result of a

particular quantum information processing operation. Devices implemented using the quantum Zeno effect can operate with low error rates without the need for high efficiency detectors and large number of ancilla.

NTIS

*Photons; Quantum Mechanics; Data Processing*

**20070013909** Brookhaven National Lab., Upton, NY, USA

**Recent References: October 1, 2005 to December 31, 2005**

Winchell, D. F.; Nov. 01, 2006; 162 pp.; In English

Report No.(s): DE2006-896452; BNL-77290-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge

This document lists experimental references added to Nuclear Science References (NSR) during the period October 1, 2005 to December 31, 2005. The first section lists keynumbers and keywords sorted by mass and nuclide. The second section lists all references, ordered by keynumber.

NTIS

*Data Bases; Nuclear Structure*

**20070013911** Brookhaven National Lab., Upton, NY, USA

**Recent References: January 1, 2005 to March 31, 2005**

Winchell, D. F.; Nov. 01, 2006; 138 pp.; In English

Report No.(s): DE2006-896453; BNL-77291-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge

This document lists experimental references added to Nuclear Science References (NSR) during the period January 1, 2005 to March 31, 2005. The first section lists keynumbers and keywords sorted by mass and nuclide. The second section lists all references, ordered by keynumber.

NTIS

*Data Bases; Nuclear Structure*

**20070013916** Stanford Linear Accelerator Center, CA, USA, Stanford Univ., CA, USA, California Inst. of Tech., Pasadena, CA USA

**Direct Mediation of Meta-Stable Supersymmetry Breaking**

Kitano, R.; Ooguri, H.; Ookouchi, Y.; Dec. 01, 2006; 21 pp.; In English

Report No.(s): DE2006-896404; SLAC-PUB-12252; No Copyright; Avail.: Department of Energy Information Bridge

The supersymmetric  $SU(N(\text{sub } c))$  Yang-Mills theory coupled to  $NF$  matter fields in the fundamental representation has meta-stable vacua with broken supersymmetry when  $N(\text{sub } C) \setminus N(\text{sub } F) \setminus 3/2 N(\text{sub } C)$ . By gauging the flavor symmetry, this model can be coupled directly to the standard model. We show that it is possible to make a slight deformation to the model so that gaugino masses are generated and the Landau pole problem can be avoided. The deformed model has simple realizations on intersecting branes in string theory, where various features of the meta-stable vacua are encoded geometrically as brane configurations.

NTIS

*Broken Symmetry; Supersymmetry*

**20070013923** Stanford Linear Accelerator Center, CA, USA, Stanford Linear Accelerator Center, Menlo Park, CA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Reheating Metastable O Raifeartaigh Models**

Craig, N. J.; Fox, P. J.; Wacker, J. G.; Dec. 01, 2006; 22 pp.; In English

Report No.(s): DE2006-896412; SLAC-PUB-12215; No Copyright; Avail.: National Technical Information Service (NTIS)

In theories with multiple vacua, reheating to a temperature greater than the height of a barrier can stimulate transitions from a desirable metastable vacuum to a lower energy state. We discuss the constraints this places on various theories and demonstrate that in a class of supersymmetric models this transition does not occur even for arbitrarily high reheating temperature.

NTIS

*Heating; High Temperature; Metastable State; Supersymmetry; Vacuum; Mathematical Models*

**20070013948** Stanford Linear Accelerator Center, Menlo Park, CA, USA, Nevada Univ., Reno, NV, USA, California Inst. of Tech., Pasadena, CA, USA

**Turn-by-Turn Imaging of the Transverse Beam profile in PEP-II**

Fisher, A. S.; Petree, M.; Kraus, R.; Au, Y. S.; Chan, B.; May 01, 2006; 10 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-896414; SLAC-PUB-11851; No Copyright; Avail.: National Technical Information Service (NTIS)

During injection or instability, the transverse profile of an individual bunch in a storage ring can change significantly in a few turns. However, most synchrotron-light imaging techniques are not designed for this time scale. We have developed a novel diagnostic that enhances the utility of a fast gated camera by adding, inexpensively, some features of a dual-axis streak camera, in order to watch the turn-by-turn evolution of the transverse profile, in both x and y. The beams elliptical profile is reshaped using cylindrical lenses to form a tall and narrow ellipse, essentially the projection of the full ellipse onto one transverse axis. We do this projection twice, by splitting the beam into two paths at different heights, and rotating the ellipse by 90DG on one path. A rapidly rotating mirror scans these vertical pencils of light horizontally across the photocathode of the camera, which is gated for 3 ns on every Nth ring turn. A single readout of the camera captures 100 images, looking like a stroboscopic photograph of a moving object. We have observed the capture of injected charge into a bunch and the rapid change of beam size at the onset of a fast instability.

NTIS

*Cameras; Imaging Techniques; Storage Rings (Particle Accelerators)*

**20070013949** Stanford Linear Accelerator Center, Menlo Park, CA, USA, Wisconsin Univ., Madison, WI, USA

**Polarization Possibilities of Small Spin-Orbit Interaction in Strained-Superlattice Photocathodes**

Maruyama, T.; Brachmann, A.; Clendenin, E. E.; Garwin, E. L.; Ioakeimidi, K.; Dec. 01, 2006; 5 pp.; In English

Report No.(s): DE2006-896417; SLAC-PUB-12256; No Copyright; Avail.: Department of Energy Information Bridge

Strained-superlattice photocathodes based on InGaP/GaAs were investigated. The photocathode performance is found highly dependent on the superlattice parameters. The electron confinement energy in superlattice appears important.

NTIS

*Electrons; Photocathodes; Spin-Orbit Interactions; Superlattices*

**20070013950** Stanford Linear Accelerator Center, CA, USA, Stanford Univ., CA, USA

**Issues in Type IIA Uplifting**

Kalosh, R.; Soroush, M.; Dec. 07, 2006; 8 pp.; In English

Report No.(s): DE2006-896418; SLAC-PUB-12251; No Copyright; Avail.: Department of Energy Information Bridge

Moduli stabilization in the type IIA massive string theory so far was achieved only in the AdS vacua. The uplifting to dS vacua has not been performed as yet: neither the analogs of type IIB anti-D3 brane at the tip of the conifold, nor the appropriate D-terms have been identified. The hope was recently expressed that the F-term uplifting may work. We investigate this possibility in the context of a simplified version of the type IIA model developed in hep-th/0505160 and find that the F-term does not uplift the AdS vacua to dS vacua with positive CC. Thus it remains a challenging task to find phenomenologically acceptable vacua in the type IIA string theory.

NTIS

*String Theory; Strings*

**20070013954** Brookhaven National Lab., Upton, NY USA

**High Spatial-Resolution Imaging of Te Inclusions in CZT Material**

Camarda, G. G.; Bolotnikov, A. E.; Carini, G. A.; Cui, Y.; Kohman, K. T.; Aug. 13, 2006; 8 pp.; In English

Report No.(s): DE2006-896445; BNL-77075-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

We present new results from our studies of defects in current single-crystal CdZnTe material. Our previous measurements, carried out on thin ((approx)1 mm) and long (approx 12 mm) CZT detectors, indicated that small (1-20 (micro)m) Te inclusions can significantly degrade the device's energy resolution and detection efficiency. We are conducting detailed studies of the effects of Te inclusions by employing different characterization techniques with better spatial resolution, such as quantitative fluorescence mapping, X-ray micro-diffraction, and TEM. Also, IR microscopy and gamma-mapping with pulse-shape analysis with higher spatial resolution generated more accurate results in the areas surrounding the micro-defects (Te inclusions). Our results reveal how the performance of CdZnTe detectors is influenced by Te inclusions, such as their spatial

distribution, concentration, and size. We also discuss a model of charge transport through areas populated with Te inclusions.  
NTIS

*Crystal Defects; High Resolution; Imaging Techniques; Inclusions; Spatial Resolution; Tellurium Alloys; Zinc Alloys*

**20070013956** Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA

**Nucleon Form Factor Experiments and the Pion Cloud**

de Jager, K.; Nov. 21, 2006; 9 pp.; In English

Report No.(s): DE2006-895546; No Copyright; Avail.: National Technical Information Service (NTIS)

The experimental and theoretical status of elastic electron scattering from the nucleon is reviewed. A wealth of new data of unprecedented precision, especially at small values of the momentum transfer, in parallel to new theoretical insights, has allowed sensitive tests of the influence of the pionic cloud surrounding the nucleon.

NTIS

*Form Factors; Nucleons; Pions; Electron Clouds; Electron Scattering*

**20070013957** Carnegie-Mellon Univ., Pittsburgh, PA, USA

**Polarization of Hyperons in Elementary Photoproduction**

Schumacher, R.; Nov. 21, 2006; 6 pp.; In English

Report No.(s): DE2006-895550; No Copyright; Avail.: National Technical Information Service (NTIS)

Recent measurements using the CLAS detector at Jefferson Lab of the reactions  $(\gamma) + p$  (yields)  $K(\text{sup } +) + (\text{Lambda})$  and  $(\gamma) + p$  (yields)  $K(\text{sup } +) + (\text{Sigma})(\text{sup } 0)$  have been used to extract the spin transfer coefficients  $C(\text{sub } x)$  and  $C(\text{sub } z)$  for the first time. These observables quantify the degree of the photon circular polarization that is transferred to the recoiling hyperons in the scattering plane. The unexpected result is that  $(\text{Lambda})$  hyperons are produced '100% polarized' as seen when combining  $C(\text{sub } x)$  and  $C(\text{sub } z)$  with the induced transverse polarization,  $P$ . Furthermore,  $C(\text{sub } x)$  and  $C(\text{sub } z)$  seem to be linearly related. This paper discusses the experimental results and offers a hypothesis which can explain these observations. We show how the produced strange quark can be subject to a pure spin-orbit type of interaction which preserves its state of polarization throughout the hadronization process.

NTIS

*Hyperons; Photoproduction; Polarization; Elementary Particles*

**20070013977** NASA Johnson Space Center, Houston, TX, USA

**Broken Symmetry and Coherent Structure in MHD Turbulence**

Shebalin, John V.; April 2007; 1 pp.; In English; American Physical Society, 14-17 Apr. 2007, Jacksonville, FL, USA; No Copyright; Avail.: Other Sources; Abstract Only

Absolute equilibrium ensemble theory for ideal homogeneous magnetohydrodynamic (MHD) turbulence is fairly well developed. Theory and Simulation indicate that ideal MHD turbulence non-ergodic and contains coherent structure. The question of applicability real (i.e., dissipative) MHD turbulence is examined. Results from several very long time numerical simulations on a  $64(\text{exp } 3)$  grid are presented. It is seen that coherent structure begins to form before decay dominates over nonlinearity. The connection with inverse spectral cascades and selective decay will also be discussed.

Author

*Magnetohydrodynamic Turbulence; Ergodic Process; Dissipation; Homogeneous Turbulence; Broken Symmetry*

**20070014000** Old Dominion Univ., Norfolk, VA, USA

**On the Markov Property for Nonlinear Discrete-Time Systems with Markovian Inputs**

Tejada, Arturo; Gonzalez, Oscar R.; Gray, W. Steven; Proceedings of the 2006 American Control Conference; June 16, 2006, pp. 899-904; In English; 2006 American Control Conference, 14-16 Jun. 2006, Minneapolis, MN, USA

Contract(s)/Grant(s): NCC1-03026; NNL04AA03A

Report No.(s): WeB06.01; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/ACC.2006.1655472>

The behavior of a general hybrid system in discrete-time can be represented by a non-linear difference equation  $x(k + 1) = F_k(x(k), \theta(k))$ , where  $\theta(k)$  is assumed to be a finite-state Markov chain. An important step in the stability analysis of these systems is to establish the Markov property of  $(x(k), \theta(k))$ . There are, however, no complete proofs of this property

which are simple to understand. This paper aims to correct this problem by presenting a complete and explicit proof, which uses only fundamental measure-theoretical concepts.

Author

*Markov Chains; Discrete Functions; Nonlinearity; Difference Equations; Time Functions*

**20070014587** National Nuclear Security Administration, Las Vegas, NV, USA, Lawrence Livermore National Lab., Livermore, CA USA

**Science and Technology Review, November 2006**

Sep. 29, 2006; 28 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896595; UCRL-TR-225084; No Copyright; Avail.: National Technical Information Service (NTIS)

This month's issue has the following articles: (1) Expanded Supercomputing Maximizes Scientific Discovery--Commentary by Dona Crawford; (2) Thunder's Power Delivers Breakthrough Science--Livermore's Thunder supercomputer allows researchers to model systems at scales never before possible. (3) Extracting Key Content from Images--A new system called the Image Content Engine is helping analysts find significant but hard-to-recognize details in overhead images. (4) Got Oxygen--Oxygen, especially oxygen metabolism, was key to evolution, and a Livermore project helps find out why. (5) A Shocking New Form of Laserlike Light--According to research at Livermore, smashing a crystal with a shock wave can result in coherent light.

NTIS

*Technology Assessment; Science; General Overviews*

**20070014591** Lawrence Livermore National Lab., Livermore, CA USA

**Search for Magnetic Order in delta-Pu Metal Using Muon Spin Relaxation**

Heffner, R. H.; Ohishi, K.; Fluss, M. J.; Morris, G. D.; McLaughlin, D. E.; Oct. 16, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896601; UCRL-PROC-225444; No Copyright; Avail.: Department of Energy Information Bridge

We review results from previous muon spin relaxation ((mu)SR) measurements in applied fields of  $H(\text{sub } 0) = 0$  and 0.25 T which established an upper limit for the ordered or disordered frozen spin moment above  $T = 4$  K in (delta)-Pu (4.3 at. % Ga) of (micro)(sub ord) (le)  $10(\text{sup } -3)$  (mu)(sub B). In addition, we present new data in  $H(\text{sub } 0) = 0.25$  T and 2 T applied field on a highly annealed (delta)-Pu (4.3 at. % Ga) sample. Neither the muon Knight shift ( $H(\text{sub } 0) = 2$  T) nor the inhomogeneous linewidths in the new sample show appreciable temperature dependence below about  $T = 60$  K, also consistent with no spin freezing. Recent theoretical arguments advanced to explain these results are mentioned.

NTIS

*Magnetic Fields; Magnetic Relaxation; Muon Spin Rotation; Muons*

**20070014596** Lawrence Livermore National Lab., Livermore, CA USA

**Science and Technology Review: Livermore Wins Seven R&D 100 Awards**

Oct. 2006; 32 pp.; In English

Report No.(s): DE2006-896611; No Copyright; Avail.: Department of Energy Information Bridge

This month's issue has the following articles: (1) Innovative Solutions Reap Rewards--Commentary by George H. Miller; (2) Surveillance on the Fly--An airborne surveillance system can track up to 8,000 moving objects in an area the size of a small city; (3) A Detector Radioactive Particles Can't Evade--An ultrahigh-resolution spectrometer can detect the minute thermal energy deposited by a single gamma ray or neutron; (4) Babel Speeds Communication among Programming Languages--The Babel program allows software applications in different programming languages to communicate quickly; (5) A Gem of a Software Tool--The data-mining software Sapphire allows scientists to analyze enormous data sets generated by diverse applications; (6) Interferometer Improves the Search for Planets--With externally dispersed interferometry, astronomers can use an inexpensive, compact instrument to search for distant planets; (7) Efficiently Changing the Color of Laser Light--Yttrium-calcium-oxyborate crystals provide an efficient, compact approach to wavelength conversion for high-average-power lasers; (8) Pocket-Sized Test Detects Trace Explosives--A detection kit sensitive to more than 30 explosives provides an inexpensive, easy-to-use tool for security forces everywhere; (9) Tailor-Made Microdevices Serve Big Needs--The Center for Micro- and Nanotechnology develops tiny devices for national security.

NTIS

*Research and Development; Technology Utilization*



**20070014678** Lawrence Livermore National Lab., Livermore, CA USA

**Benchmark Calculation of Inclusive Responses in the Four-Body Nuclear System**

Quaglioni, S.; Stetcu, I.; Bacca, S.; Barrett, B. R.; Johnson, C. W.; Sep. 28, 2006; 6 pp.; In English

Report No.(s): DE2006-896615; UCRL-PROC-224820; No Copyright; Avail.: Department of Energy Information Bridge

This paper reports on a recent benchmark calculation in the four-nucleon system, aimed at investigating the reliability of the no-core shell model (NCSM) approach to the description of inclusive response functions via the Lorentz integral transform (LIT) method.

NTIS

*Nuclear Physics; Nucleons; Four Body Problem*

**20070014680** Lawrence Livermore National Lab., Livermore, CA USA

**Neutron Radiation Shielding for the NIF Streaked X-Ray Detector (SXD) Diagnostic**

Song, P.; Holder, J.; Young, B.; Kalantar, D.; Eder, D.; Nov. 09, 2006; 7 pp.; In English

Report No.(s): DE2006-896618; UCRL-CONF-225998; No Copyright; Avail.: National Technical Information Service (NTIS)

The National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) is preparing for the National Ignition Campaign (NIC) scheduled in 2010. The NIC is comprised of several 'tuning' physics subcampaigns leading up to a demonstration of Inertial Confinement Fusion (ICF) ignition. In some of these experiments, time-resolved x-ray imaging of the imploding capsule may be required to measure capsule trajectory (shock timing) or x-ray 'bang-time'. A capsule fueled with pure tritium (T) instead of a deuterium-tritium (DT) mixture is thought to offer useful physics surrogacy, with reduced yields of up to  $5 \times 10^{14}$  neutrons. These measurements will require the use of the NIF streak x-ray detector (SXD). The resulting prompt neutron fluence at the planned SXD location ((approx)1.7 m from the target) would be (approx) $1.4 \times 10^9/\text{cm}^2$ . Previous measurements suggest the onset of significant background at a neutron fluence of (approx)  $1 \times 10^8/\text{cm}^2$ . The radiation damage and operational upsets which starts at (approx) $1 \times 10^8$  rad-Si/sec must be factored into an integrated experimental campaign plan. Monte Carlo analyses were performed to predict the neutron and gamma/x-ray fluences and radiation doses for the proposed diagnostic configuration. A possible shielding configuration is proposed to mitigate radiation effects. The primary component of this shielding is an 80 cm thickness of Polyethylene (PE) between target chamber center (TCC) and the SXD diagnostic. Additionally, 6-8 cm of PE around the detector provide from the large number of neutrons that scatter off the inside of the target chamber. This proposed shielding configuration reduces the high-energy neutron fluence at the SXD by approximately a factor (approx)50.

NTIS

*Dosage; Ignition; Neutrons; Radiation Shielding; Shielding; X Ray Detectors*

**20070014684** Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA

**Standard Model Tests via Parity Violating Electron Scattering**

Micheals, R.; Carlini, R.; Oct. 02, 2006; 6 pp.; In English

Contract(s)/Grant(s): AC05-84ER40150

Report No.(s): DE2006-896506; JLAB-PHY-06-592; DOE/ER/40150-4167; No Copyright; Avail.: National Technical Information Service (NTIS)

A new generation of parity violating electron scattering measurements at high precision probe for physics beyond Standard Model. The experiments are complementary to high energy experiments and provide indirect access to TeV scale physics via electroweak one-loop effects. Data are presented from the recently completed SLAC experiment E158, which measured the weak charge of the electron  $Q(\text{sub } W)(\text{sup } e)$ . The  $Q_{\text{weak}}$  experiment at Jefferson Lab will measure the weak charge of the proton  $Q(\text{sub } W)(\text{sup } p)$  to an accuracy of 4.3%.

NTIS

*Electron Scattering; Electrons; Linear Accelerators; Parity; Scattering; Standard Model (Particle Physics)*

**20070014687** Cornell Univ., Ithaca, NY, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, London Univ., UK, Stanford Linear Accelerator Center, CA, USA

**Performance of a Nanometer Resolution BPM System**

Walston, S.; Chung, C.; Fitsos, P.; Gronberg, J.; Meller, R.; Jun. 21, 2006; 5 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896562; UCRL-PROC-222331; No Copyright; Avail.: Department of Energy Information Bridge

International Linear Collider (ILC) interaction region beam sizes and component position stability requirements will be as small as a few nanometers. It is important to the ILC design effort to demonstrate that these tolerances can be achieved--ideally using beam-based stability measurements. It has been estimated that RF cavity beam position monitors (BPMs) could provide position measurement resolutions of less than one nanometer and could form the basis of the desired beam-based stability measurement. We have developed a high resolution RF cavity BPM system. A triplet of these BPMs has been installed in the extraction line of the KEK Accelerator Test Facility (ATF) for testing with its ultra-low emittance beam. The three BPMs are rigidly mounted inside an alignment frame on variable-length struts which allow movement in position and angle. We have developed novel methods for extracting the position and tilt information from the BPM signals including a calibration algorithm which is immune to beam jitter. To date, we have been able to demonstrate a resolution of approximately 20 nm over a dynamic range of +/- 20 microns.

NTIS

*Beams (Radiation); Monitors; Position (Location); Linear Accelerators*

**20070014688** Lawrence Livermore National Lab., Livermore, CA USA, Princeton Univ., NJ USA, Oak Ridge National Lab., TN USA

**Magnetic Field Line Tracing Calculations for Conceptual PFC Design in the National Compact Stellarator Experiment**

Maingi, R.; Kaiser, T.; Hill, D. N.; Lyon, J. P.; Monticello, D.; Jun. 12, 2006; 6 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896566; UCRL-CONF-222081; No Copyright; Avail.: Department of Energy Information Bridge

The National Compact Stellarator Experiment (NCSX) is a three-field period compact stellarator presently in the construction phase at Princeton, NJ. The design parameters of the device are major radius  $R=1.4\text{m}$ , average minor radius  $\langle r \rangle = 0.32\text{m}$ , 1.2 less than toroidal field (Bt) less than 1.7 T, and auxiliary input power up to 12 MW with neutral beams and radio-frequency heating. The NCSX average aspect ratio  $\langle r/R \rangle$  of 4.4 lies well below present stellarator experiments and designs, enabling the investigation of high Beta physics in a compact stellarator geometry. Also the NCSX design choice for a quasi-axisymmetric configuration aims toward the achievement of tokamak-like transport. In this paper, we report on the magnetic field line tracing calculations used to evaluate conceptual plasma facing component (PFC) designs.

NTIS

*Magnetic Fields; Stellarators; Plasma Physics; Algorithms*

**20070014689** Lawrence Livermore National Lab., Livermore, CA USA

**Some Physics Processes in the Nitrogen-Filled Photoluminescence Cell**

Ryutov, D. D.; Jun. 19, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896567; UCRL-TR-222274; No Copyright; Avail.: Department of Energy Information Bridge

The photoluminescence cell is a viable candidate for monitoring the total energy in the Linac Coherent Light Source. Most of the discussion was concentrated on the cell with argon as a working gas. In the present note I provide a discussion of some physics processes that may affect the performance of the photoluminescence cell with the nitrogen fill. In particular, I will consider the role of the space charge effects, ambipolar diffusion, and recombination processes. This group of phenomena determines the duration of the afterglow process that follows an initial short ( $\sim 100$  ns) burst of optical radiation. The presence of this afterglow can be of some significance for the detection system. The general template for this discussion follows a draft report where the argon-filled cell was considered. But some processes in nitrogen are different and require separate consideration. In what follows, I am not attempting to produce 'exact' results, but rather to provide a quick order-of-magnitude scoping study.

NTIS

*Nitrogen; Photoluminescence*

**20070014694** Rudnick (Pipe), Washington, DC, USA

**Q-Point Stabilization for Linear Interferometric Sensors using Tunable Diffraction Grating**

Wang, A.; Yu, B.; 15 Apr 04; 18 pp.; In English

Contract(s)/Grant(s): DE-FC3601GO11050

Patent Info.: Filed Filed 15 Apr 04; US-Patent-Appl-SN-10-824-600

Report No.(s): PB2007-105990; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A linear interferometric sensor system in which the light output from the interferometric sensor is optically bandpass

filtered before conversion to an electrical signal by an adjustable diffraction grating and the center wavelength of the adjustable diffraction grating is controlled by a feedback circuit responsive to the steady state component of the electrical signal corresponding to the filtered sensor return. The adjustable may comprise a diffraction grating a diffraction grating mounted on a motor driven rotary stage. The invention is particularly useful in self calibrating interferometric/intensity-based sensor configuration, but is also applicable in a wide variety of linear interferometric sensor configurations.

NTIS

*Gratings (Spectra); Interferometers; Interferometry; Tunable Lasers*

**20070014704** Lawrence Livermore National Lab., Livermore, CA USA

**Design and Modeling of 40 keV X-Ray Optics for Titan Experiment**

Bajt, S.; Jun. 22, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896572; UCRL-TR-222379; No Copyright; Avail.: Department of Energy Information Bridge

In 2004 we designed and fabricated a 40 keV W/SiC multilayer coated mirrors with 2.0 nm period thickness that were tested at RAL (UK) in winter 2004/2005. The mirrors reflected from 35 to 70 keV (different grazing incidence angles) and showed high reflectivity. However, there was not enough beamtime at RAL to obtain quantitative results. Similar experiment will now be performed in Titan facility (LLNL). In this report we design and model multilayers with even shorter period than the ones used in 2004/2005 experiments. Our goal is to fabricate 1 nm period W/SiC multilayers with high reflectivity. This will enable operation at higher angle of grazing incidence and simplified the mounting fixture.

NTIS

*Titan; X Ray Lasers; X Ray Optics*

**20070014710** Carnegie-Mellon Univ., Pittsburgh, PA USA

**GlueX Experiment**

Meyer, C. A.; Nov. 01, 2006; 4 pp.; In English

Contract(s)/Grant(s): AC05-06OR23177

Report No.(s): DE2006-896490; JLAB-PHY-06-594; DOE/OR/23177-0015; No Copyright; Avail.: Department of Energy Information Bridge

The GlueX experiment at Jefferson Lab is part of the planned CEBAF 12GeV upgrade. The project received its Critical Decision 1 (CD1) in February of 2006, and CD2 is anticipated in 2007. The GlueX experiment will search for and study the spectrum of gluonic excitations of mesons in the 1.5 to 2.5 GeV/c<sup>2</sup> mass region using an 8.5 to 9 GeV beam of linearly polarized photons.

NTIS

*Gluons; Linear Accelerators; Excitation; Linear Polarization*

**20070014711** Lawrence Livermore National Lab., Livermore, CA USA

**Some Physics Processes in the Nitrogen-Filled Photoluminescence Cell. Revision One**

Ryutov, D. D.; Jun. 22, 2006; 9 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896573; UCRL-TR-222388; No Copyright; Avail.: Department of Energy Information Bridge

The photoluminescence cell is a viable candidate for monitoring the total energy in the Linac Coherent Light Source. Most of the discussion was concentrated on the cell with argon as a working gas. In the present note I provide a discussion of some physics processes that may affect the performance of the photoluminescence cell with the nitrogen fill. In particular, I will consider the role of the space charge effects, ambipolar diffusion, and recombination processes. This group of phenomena determines the duration of the afterglow process that follows an initial short ( $\sim 100$  ns) burst of optical radiation. The presence of this afterglow can be of some significance for the detection system. Compared to my previous note with the same title UCRL-TR-222274, a more detailed discussion of space charge effects is provided, with an emphasis on the electrostatic confinement of the primary electrons. Also, some additional atomic data are included into sections describing recombination processes. The general template for this discussion follows a draft report where the argon-filled cell was considered. But some processes in nitrogen are different and require separate consideration. In what follows, I am not attempting to produce 'exact' results, but rather to provide a quick order-of-magnitude scoping study.

NTIS

*Nitrogen; Photoluminescence; Physics*

**20070014713** Massachusetts Univ., Amherst, MA, USA

**Parity-Violating Electron Scattering: New Results and Future Prospects**

Koman, K. S.; Nov. 01, 2006; 9 pp.; In English

Contract(s)/Grant(s): FG02-88R40415-A018; AC05-84ER40150

Report No.(s): DE2006-896491; JLAB-THY-06-594; DOE/ER/40150-4164; No Copyright; Avail.: Department of Energy Information Bridge

We discuss the status and prospects of an experimental program of parity-violating asymmetry measurements in the scattering of longitudinally polarized electrons off unpolarized fixed targets. One thrust is the measurements of nucleon neutral weak form factors at intermediate four-momentum transfer ( $0.1 \leq Q^2 \leq 1$ ) (GeV/c)<sup>2</sup> which provide information about the role of virtual strange quarks on the charge and current distributions inside nucleons. A new topic is the elastic neutral weak amplitude from scattering off a heavy spinless nucleus, which is sensitive to the presence of a neutron skin. Finally, we discuss the neutral current elastic amplitude at very low  $Q^2$ , which allows precision measurements of the weak mixing angle at low energy and is thus sensitive to new physics at the TeV scale. The physics implications of recent results, potential measurements from experiments under construction as well as new ideas at future facilities are discussed.

NTIS

*Parity; Electron Scattering; Asymmetry; Nuclear Physics*

**20070014714** Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA

**Deeply Virtual Compton Scattering and Nucleon Structure**

Garcon, M.; Nov. 01, 2006; 9 pp.; In English

Contract(s)/Grant(s): AC05-84ER40150

Report No.(s): DE2006-896492; JLAB-PHY-06-586; DOE/ER/40150-4165; No Copyright; Avail.: Department of Energy Information Bridge

Deeply Virtual Compton Scattering (DVCS) is the tool of choice to study Generalized Parton Distributions (GPD) in the nucleon. After a general introduction to the subject, a review of experimental results from various facilities is given. Following the first encouraging results, new generation dedicated experiments now allow unprecedented precision and kinematical coverage. Several new results were presented during the conference, showing significant progress in this relatively new field. Prospects for future experiments are presented. The path for the experimental determination of GPDs appears now open.

NTIS

*Compton Effect; Electron Scattering; Nucleons*

**20070014719** Lawrence Livermore National Lab., Livermore, CA USA

**Calculation of Neutral Beam Injection into SSPX**

Pearlstein, L. D.; Casper, T. A.; Hill, D. N.; LoDestro, L. L.; McLean, H. S.; Jun. 13, 2006; 6 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896581; UCRL-CONF-222188; No Copyright; Avail.: Department of Energy Information Bridge

The SSPX spheromak experiment has achieved electron temperatures of 350eV and confinement consistent with closed magnetic surfaces. In addition, there is evidence that the experiment may be up against an operational beta limit for Ohmic heating. To test this barrier, there are firm plans to add two 0.9MW Neutral Beam (NB) sources to the experiment. A question is whether the limit is due to instability. Since the deposited Ohmic power in the core is relatively small the additional power from the beams is sufficient to significantly increase the electron temperature. Here we present results of computations that will support this contention. We have developed a new NB module to calculate the orbits of the injected fast ions. The previous computation made heavy use of tokamak ordering which fails for a tight-aspect-ratio device, where  $B(\text{sub tor})$  (approx.)  $B(\text{sub pol})$ . The model calculates the deposition from the NFREYA package. The neutral from the CX deposition is assumed to be ionized in place, a high-density approximation. The fast ions are then assumed to fill a constant angular momentum orbit. And finally, the fast ions immediately assume the form of a dragged down distribution.

NTIS

*Beam Injection; Neutral Beams; Spheromaks*

**20070014727** Lawrence Livermore National Lab., Livermore, CA USA

**Surface Modification Energized by Focused Ion Beam: The Influence of Etch Rates and Aspect Ratio on Ripple Wavelengths**

MoberlyChan, W. J.; Nov. 16, 2006; 8 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896588; UCRL-PROC-226187; No Copyright; Avail.: National Technical Information Service (NTIS)

Ion beams have been used to modify surface topography, producing nanometer-scale modulations (and even subnanometer ripples in this work) that have potential uses ranging from designing self-assembly structures, to controlling stiction of micromachined surfaces, to providing imprint templates for patterned media. Modern computer-controlled Focused Ion Beam tools enable alternating submicron patterned zones of such ion-eroded surfaces, as well as dramatically increasing the rate of ion beam processing. The DualBeam FIB/SEM also expedites process development while minimizing the use of materials that may be precious (Diamond) and/or produce hazardous byproducts (Beryllium). A FIB engineer can prototype a 3-by-3-by-3 matrix of variables in tens of minutes and consume as little as zeptoliters of material; whereas traditional ion beam processing would require tens of days and tens of precious wafers. Saturation wavelengths have been reported for ripples on materials such as single crystal silicon or diamond ((approx.) 200nm); however this work achieves wavelengths  $\approx 400$ nm on natural diamond. Conversely, Be can provide a stable and ordered 2-dimensional array of  $\approx 40$ nm periodicity; and ripples  $\approx 0.4$ nm are also fabricated on carbon surfaces and quantified by HR-TEM and electron diffraction. Rippling is a function of material, ion beam, and angle; but is also controlled by chemical environment, redeposition, and aspect ratio.

NTIS

*Aspect Ratio; Etching; Ion Beams; Ripples*

**20070014733** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Overview of Light-Ion Beam Therapy**

Chu, W. T.; Mar. 2006; 20 pp.; In English

Report No.(s): DE2007-889628; No Copyright; Avail.: National Technical Information Service (NTIS)

In 1930, Ernest Orlando Lawrence at the University of California at Berkeley invented the cyclotron. One of his students, M. Stanley Livingston, constructed a 13-cm diameter model that had all the features of early cyclotrons, accelerating protons to 80 keV using less than 1 kV on a semi-circular accelerating electrode, now called the 'dee'. Soon after, Lawrence constructed the first two-dee 27-Inch (69-cm) Cyclotron, which produced protons and deuterons of 4.8 MeV. In 1939, Lawrence constructed the 60-Inch (150-cm) Cyclotron, which accelerated deuterons to 19 MeV. Just before WWII, Lawrence designed a 184-inch cyclotron, but the war prevented the building of this machine. Immediately after the war ended, the Veksler-McMillan principle of phase stability was put forward, which enabled the transformation of conventional cyclotrons to successful synchrocyclotrons. When completed, the 184-Inch Synchrocyclotron produced 340-MeV protons. Following it, more modern synchrocyclotrons were built around the globe, and the synchrocyclotrons in Berkeley and Uppsala, together with the Harvard cyclotron, would perform pioneering work in treatment of human cancer using accelerated hadrons (protons and light ions). When the 184-Inch Synchrocyclotron was built, Lawrence asked Robert Wilson, one of his former graduate students, to look into the shielding requirements for of the new accelerator. Wilson soon realized that the 184-Inch would produce a copious number of protons and other light ions that had enough energy to penetrate human body, and could be used for treatment of deep-seated diseases. Realizing the advantages of delivering a larger dose in the Bragg peak when placed inside deep-seated tumors, he published in a medical journal a seminal paper on the rationale to use accelerated protons and light ions for treatment of human cancer. The precise dose localization provided by protons and light ions means lower doses to normal tissues adjacent to the treatment volume compared to those in conventional (photon) treatments. Wilson wrote his personal account of this pioneering work in 1997. In 1954 Cornelius Tobias and John Lawrence at the Radiation Laboratory (former E.O. Lawrence Berkeley National Laboratory) of the University of California, Berkeley performed the first therapeutic exposure of human patients to hadron (deuteron and helium ion) beams at the 184-Inch Synchrocyclotron.

NTIS

*Ion Beams; Light Ions; Nuclear Physics; Therapy*

**20070014735** Santander Univ., Cantabria, Santander, Spain

**Top Physics at CDF. (Proceeding for the Lake Louise Winter Institute 2006 Talk.)**

Palencia, E.; Apr. 12, 2006; 6 pp.; In English

Report No.(s): DE2007-892311; CDF/PUB/TOP/PUBLIC/8191; No Copyright; Avail.: National Technical Information Service (NTIS)



The top quark is the most massive fundamental particle observed so far, and the study of its properties is interesting for several reasons ranging from its possible special role in electroweak symmetry breaking to its sensitivity to physics beyond the Standard Model (SM). This article focuses on the latest top physics results from CDF based on 320-750 pb(sup -1) of p(bar p) collision data at (radical)s = 1.96 TeV. The t(bar t) cross section and the top mass have been measured in different decay channels and using different methods. They have also searched for massive t(bar t) resonances.

NTIS

*Lakes; Quarks; Winter*

**20070014737** Fermi National Accelerator Lab., Batavia, IL, USA

#### **Data Production Models for the CDF Experiment**

Antos, J.; Babik, M.; Benjamin, D.; Cabrera, S.; Chen, Y. C.; Jun. 2006; 8 pp.; In English

Report No.(s): DE2007-892423; FERMILAB-CONF-05-622-CD-E; No Copyright; Avail.: National Technical Information Service (NTIS)

The data production for the CDF experiment is conducted on a large Linux PC farm designed to meet the needs of data collection at a maximum rate of 40 MByte/sec. We present two data production models that exploits advances in computing and communication technology. The first production farm is a centralized system that has achieved a stable data processing rate of approximately 2 TByte per day. The recently upgraded farm is migrated to the SAM (Sequential Access to data via Metadata) data handling system. The software and hardware of the CDF production farms has been successful in providing large computing and data throughput capacity to the experiment.

NTIS

*Data Processing; Computer Programs; Computers; Data Acquisition*

**20070014771** Lawrence Livermore National Lab., Livermore, CA USA

#### **New Experimental Measurements of Electron Clouds in Ion Beams with Large Tune Depression**

Molvik, W. W.; Covo, M. K.; Friedman, A.; Cohen, R.; Lund, S. M.; Jun. 09, 2006; 7 pp.; In English

Report No.(s): DE2006-896288; UCRL-CONF-221918; No Copyright; Avail.: National Technical Information Service (NTIS)

We study electron clouds in high perveance beams ( $K = 8E-4$ ) with a large tune depression of 0.10 (defined as the ratio of a single particle oscillation response to the applied focusing fields, with and without space charge). These 1 MeV, 180 mA, K+ beams have a beam potential of +2 kV when electron clouds are minimized. Simulation results are discussed in companion papers. We have developed new quantitative measurements, including the first quantitative measurements of the accumulation of electrons in a positively-charged beam. This, together with measurements of electron sources, will enable the electron particle balance to be measured, and electron-trapping efficiencies determined. We also measure details of and simulate 10 MHz electron oscillations in the last quadrupole magnet when we flood the beam with electrons from an end wall. Emerging measurements that show promise but are not thoroughly tested, include the trapping depth of electrons.

NTIS

*Electron Clouds; Ion Beams*

**20070014773** Lawrence Livermore National Lab., Livermore, CA USA

#### **New Simulation Capabilities of Electron Clouds in Ion Beams with Large Tune Depression**

Vay, J. L.; Furman, M. A.; Seidl, P. A.; Cohen, R. H.; Friedman, A.; Jun. 09, 2006; 6 pp.; In English

Report No.(s): DE2006-896292; UCRL-CONF-221940; No Copyright; Avail.: National Technical Information Service (NTIS)

We have developed a new, comprehensive set of simulation tools aimed at modeling the interaction of intense ion beams and electron clouds (e-clouds). The set contains the 3-D accelerator PIC code WARP and the 2-D 'slice' e-cloud code POSINST (M. Furman, this workshop, paper TUAX05), as well as a merger of the two, augmented by new modules for impact ionization and neutral gas generation. The new capability runs on workstations or parallel supercomputers and contains advanced features such as mesh refinement, disparate adaptive time stepping, and a new 'drift-Lorentz' particle mover for tracking charged particles in magnetic fields using large time steps. It is being applied to the modeling of ion beams (1 MeV, 180 mA, K+) for heavy ion inertial fusion and warm dense matter studies, as they interact with electron clouds in the High-Current Experiment (HCX) (experimental results discussed by A. Molvik, this workshop, paper THAW02). We describe the capabilities and present recent simulation results with detailed comparisons against the HCX experiment, as well as their

application (in a different regime) to the modeling of e-clouds in the Large Hadron Collider (LHC).

NTIS

*Electron Clouds; Ion Beams; Simulation*

**20070014777** Fermi National Accelerator Lab., Batavia, IL, USA, New Mexico Univ., Albuquerque, NM, USA

**Heavy Flavor Production in CDF II Detector**

Gorelov, I. V.; Jan. 01, 2006; 5 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-879116; FERMILAB-CONF-06-002-E; No Copyright; Avail.: National Technical Information Service (NTIS)

For data collected with the CDF Run II detector, measurements of the charm and bottom production cross-sections are presented. The results are based both on large samples of fully reconstructed hadron decay products of charm and bottom made available by the tracking triggers and on a calorimeter jet triggered sample tagged by the presence of a secondary vertex. The experimental data are compared with theoretical predictions from recent next-to-leading order (NLO) QCD calculations.

NTIS

*Quantum Chromodynamics; Particle Decay; Nuclides*

**20070014779** Lawrence Livermore National Lab., Livermore, CA USA

**Monte Carlo Particle Transport Capability for Inertial Confinement Fusion Applications**

Brantley, P. S.; Stuart, L. M.; Nov. 13, 2006; 7 pp.; In English

Report No.(s): DE2006-896620; UCRL-CONF-226076; No Copyright; Avail.: Department of Energy Information Bridge

A time-dependent massively-parallel Monte Carlo particle transport calculational module (ParticleMC) for inertial confinement fusion (ICF) applications is described. The ParticleMC package is designed with the long-term goal of transporting neutrons, charged particles, and gamma rays created during the simulation of ICF targets and surrounding materials, although currently the package treats neutrons and gamma rays. Neutrons created during thermonuclear burn provide a source of neutrons to the ParticleMC package. Other user-defined sources of particles are also available. The module is used within the context of a hydrodynamics client code, and the particle tracking is performed on the same computational mesh as used in the broader simulation. The module uses domain-decomposition and the MPI message passing interface to achieve parallel scaling for large numbers of computational cells. The Doppler effects of bulk hydrodynamic motion and the thermal effects due to the high temperatures encountered in ICF plasmas are directly included in the simulation. Numerical results for a three-dimensional benchmark test problem are presented in 3D XYZ geometry as a verification of the basic transport capability. In the full paper, additional numerical results including a prototype ICF simulation will be presented.

NTIS

*Confinement; Inertial Confinement Fusion; Monte Carlo Method; Simulation*

**20070014780** Lawrence Livermore National Lab., Livermore, CA USA

**Coulomb Excitation of the 242mAm Isomer**

Hayes, A. B.; Cline, D.; Moody, K. J.; Carpenter, M. P.; Carroll, J. J.; Nov. 01, 2006; 7 pp.; In English

Report No.(s): DE2006-896621; UCRL-CONF-225750; No Copyright; Avail.: Department of Energy Information Bridge

The (sup 242m)Am isomer, a well-known candidate for photo-depopulation research, has been studied in this first ever Coulomb excitation of a nearly pure ((approx) 98%) isomer target. Thirty new states, including a new rotational band built on a  $K(\text{sup } \pi) = 6(\text{sup } -)$  state have been identified. Strong K-mixing results in nearly equal populations of the  $K(\text{sup } \pi) = 5(\text{sup } -)$  and  $6(\text{sup } -)$  states. Newly identified states have been assigned to the  $K(\text{sup } \pi) = 3(\text{sup } -)$  rotational band, the lowest states of which are known to decay into the ground-state band. Implications regarding K-mixing and Coulomb excitation paths to the ground state are discussed.

NTIS

*Excitation; Isomers*

**20070014781** Lawrence Livermore National Lab., Livermore, CA USA

**Equation of State for High Explosives Detonation Product with Explicit Polar And Ionic Species**

Bastea, S.; Glaesemann, K. R.; Fried, L. E.; Jun. 29, 2006; 9 pp.; In English

Report No.(s): DE2006-896622; UCRL-CONF-222506; No Copyright; Avail.: National Technical Information Service (NTIS)

We introduce a new thermodynamic theory for detonation products that includes polar and ionic species. The new formalism extends the domain of validity of the previously developed EXP6 equation of state library and opens the possibility of new applications. We illustrate the scope of the new approach on PETN detonation properties and water ionization models. NTIS

*Chemical Explosions; Condensed Matter Physics; Detonation; Equations of State; Explosives*

**20070014782**

**gamma N to De Transition in Chiral Effective-Field Theory**

Pascalutsa, V.; Vanderhaeghen, M.; Apr. 27, 2006; 9 pp.; In English

Report No.(s): DE2006-896662; No Copyright; Avail.: National Technical Information Service (NTIS)

We describe the pion electroproduction processes in the (Delta)(1232)-resonance region within the framework of chiral effective-field theory. By studying the observables of pion electroproduction in a next-to-leading order calculation we are able to make predictions and draw conclusions on the properties of the N (yields) (Delta) electromagnetic form factors.

NTIS

*Pions; Field Theory (Physics); Chiral Dynamics; Electromagnetic Fields*

**20070014783**

**Chiral Effective Field Theory in the Delta-resonance Region**

Pascalutsa, V.; Dec. 2006; 13 pp.; In English

Report No.(s): DE2006-896663; No Copyright; Avail.: National Technical Information Service (NTIS)

I discuss the problem of constructing an effective low-energy theory in the vicinity of a resonance or a bound state. The focus is on the example of the Delta(1232), the lightest resonance in the nucleon sector. Recent developments of the chiral effective-field theory in the Delta-resonance region are briefly reviewed. I conclude with a comment on the merits of the manifestly covariant formulation of chiral EFT in the baryon sector.

NTIS

*Chirality; Field Theory (Physics); Chiral Dynamics; Baryon Resonance*

**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 and Power*.

**20070014477** Royal Netherlands Military Academy, Wageningen, Netherlands

**Analysis of Tests with the VT Silent Towing Carriage**

Boschers, J.; August 2006; 6 pp.; In English

Report No.(s): Report No. 18867-4-VT; Copyright; Avail.: Other Sources

With the decrease of machinery related noise sources, other (hydrodynamic) noise sources become more important to the underwater signature of naval vessels. A noise source of which little information is available is the noise due to the flow around the hull of surface ships. Due to the common interest, a cooperative research programme was started between the USA Navy and the Royal Netherlands Navy under Annex A to the US/NL Technology Research and Development Projects MOU dated May 14, 1998. The project agreement is titled 'Mechanisms and Prediction of Surface Ship Radiated Flow Noise'. The present report presents results carried out within task 3: 'Experimental tool development', subtask 2: 'Development of a silent towing system' and task 5: 'Small-scale model tests'. The presence of a free surface leads to the entrainment of bubbles in the water which radiate noise and may influence the turbulent boundary layer pressure fluctuations, which radiate noise through the interaction with the hull. The radiated noise due to the air entrainment by the breaking bow waves of an M-frigate has been measured at full scale using an acoustic array. The bow wave breaking and air entrainment at model scale has been investigated in 2004 for a large scale M-frigate model and it was concluded that the application of large size roughness elements at the bow would further enhance the air entrainment. For further investigation of flow noise related phenomena at model scale, an acoustic array has been developed by TNO and a silent towing mechanism has been developed by MARIN. These systems were tested in June 2005 in the MARIN Vacuum Tank (VT = Depressurized Towing Tank) (under atmospheric conditions) and the present report discusses the MARIN measurement data. TNO measured both the hull pressure fluctuations and the radiated noise using an acoustic array and their results are reported separately. In addition some tests were made in May 2006 with the model attached to the VT towing carriage in a similar way as the attachment to the silent towing carriage to measure the trim

and sinkage and to make additional photographs of the bow and stern wave system.

Derived from text

*Flow Noise; Ships; Signatures; Acoustics; Noise Propagation*

## 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.*

**20070014578** Lawrence Livermore National Lab., Livermore, CA USA

#### **Capabilities for Testing the Electronic Configuration in Pu**

Tobin, J. G.; Soderlind, P.; Landa, A.; Moore, K. T.; Schwartz, A. J.; Nov. 08, 2006; 5 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896594; UCRL-PROC-226194; No Copyright; Avail.: Department of Energy Information Bridge

The benchmarking of theoretical modeling is crucial to the ultimate determination of the nature of the electronic structure of Pu. Examples of experimental techniques used for cross checking state of the art calculations will be given.

NTIS

*Electronic Structure; Plutonium*

**20070014796** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Effect of EMIC Wave Normal Angle Distribution on Relativistic Electron Scattering in Outer RB**

Khazanov, G. V.; Gamayunov, K. V.; [2007]; 29 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): UPN 370-16-10; No Copyright; Avail.: CASI: C01, CD-ROM: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014796>

We present the equatorial and bounce average pitch angle diffusion coefficients for scattering of relativistic electrons by the H+ mode of EMIC waves. Both the model (prescribed) and self consistent distributions over the wave normal angle are considered. The main results of our calculation can be summarized as follows: First, in comparison with field aligned waves, the intermediate and highly oblique waves reduce the pitch angle range subject to diffusion, and strongly suppress the scattering rate for low energy electrons (E less than 2 MeV). Second, for electron energies greater than 5 MeV, the  $l_{nl} = 1$  resonances operate only in a narrow region at large pitch-angles, and despite their greatest contribution in case of field aligned waves, cannot cause electron diffusion into the loss cone. For those energies, oblique waves at  $l_{nl}$  greater than 1 resonances are more effective, extending the range of pitch angle diffusion down to the loss cone boundary, and increasing diffusion at small pitch angles by orders of magnitude.

Author

*Electron Scattering; High Energy Electrons; Normal Density Functions; Relativistic Particles; Angular Distribution; Outer Radiation Belt*

**20070014797** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Electrostatic Wave Generation and Transverse Ion Acceleration by Alfvénic Wave Components of BBELF Turbulence**

Singh, Nagendra; Khazanov, George; Mukhter, Ali; [2007]; 33 pp.; In English

Contract(s)/Grant(s): NAG5-13489; No Copyright; Avail.: CASI: C01, CD-ROM: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014797>

We present results here from 2.5-D particle-in-cell simulations showing that the electrostatic (ES) components of broadband extremely low frequency (BBELF) waves could possibly be generated by cross-field plasma instabilities driven by the relative drifts between the heavy and light ion species in the electromagnetic (EM) Alfvénic component of the BBELF waves in a multi-ion plasma. The ES components consist of ion cyclotron as well as lower hybrid modes. We also demonstrate that the ES wave generation is directly involved in the transverse acceleration of ions (TAI) as commonly measured with the BBELF wave events. The heating is affected by ion cyclotron resonance in the cyclotron modes and Landau resonance in the lower hybrid waves. In the simulation we drive the plasma by the transverse electric field,  $E_y$ , of the EM waves; the frequency of  $E_y$ ,  $\omega_d$ , is varied from a frequency below the heavy ion cyclotron frequency,  $\Omega_h$ , to below the light ion cyclotron frequency,  $\Omega_i$ . We have also performed simulations for  $E_y$  having a continuous spectrum given by a power law, namely,  $|E_y| \approx \omega_d^{-\alpha}$ , where the exponent  $\alpha = 0, 1, \text{ and } 2$  in three different simulations. The driving electric field generates polarization and  $E \times B$  drifts of the ions and electrons.

When the interspecies relative drifts are sufficiently large, they drive electrostatic waves, which cause perpendicular heating of both light and heavy ions. The transverse ion heating found here is discussed in relation to observations from Cluster, FAST and Freja.

Author

*Electrostatic Waves; Ion Cyclotron Radiation; Transverse Acceleration; Magnetohydrodynamic Waves; Broadband; Extremely Low Frequencies; Turbulence*

## 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*.

**20070013933** Argonne National Lab., IL USA

#### **Neutronic Assessment of Stringer Fuel Assembly Design for Liquid-Salt-Cooled Very High Temperature Reactor (LS-VHTR)**

Szakaly, F. J.; Kim, T. K.; Taiwo, T. A.; Aug. 31, 2006; 29 pp.; In English

Report No.(s): DE2006-895665; ANL-GENIV-074; No Copyright; Avail.: National Technical Information Service (NTIS)

Neutronic studies of 18-pin and 36-pin stringer fuel assemblies have been performed to ascertain that core design requirements for the Liquid-Salt Cooled Very High Temperature Reactor (LS-VHTR) can be met. Parametric studies were performed to determine core characteristics required to achieve a target core cycle length of 18 months and fuel discharge burnup greater than 100 GWd/t under the constraint that the uranium enrichment be less than 20% in order to support non-proliferation goals. The studies were done using the WIMS9 lattice code and the linear reactivity model to estimate the core reactivity balance, fuel composition, and discharge burnup. The results show that the design goals can be met using a 1-batch fuel management scheme, uranium enrichment of 15% and a fuel packing fraction of 30% or greater for the 36-pin stringer fuel assembly design.

NTIS

*High Temperature; Nuclear Reactors; Stringers; Neutrons; Fuels; Salts; Liquids; Coolants*

**20070013942** Brookhaven National Lab., Upton, NY USA

#### **Summary of General Working Group A+B+D. Codes Benchmarking**

Wdi, J.; Shaposhnikova, E.; Zimmermann, F.; Hofmann, I.; Aug. 01, 2006; 6 pp.; In English

Report No.(s): DE2006-896441; BNL-77069-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

Computer simulation is an indispensable tool in assisting the design, construction, and operation of accelerators. In particular, computer simulation complements analytical theories and experimental observations in understanding beam dynamics in accelerators. The ultimate function of computer simulation is to study mechanisms that limit the performance of frontier accelerators. There are four goals for the benchmarking of computer simulation codes, namely debugging, validation, comparison and verification: (1) Debugging--codes should calculate what they are supposed to calculate; (2) Validation--results generated by the codes should agree with established analytical results for specific cases; (3) Comparison--results from two sets of codes should agree with each other if the models used are the same; and (4) Verification--results from the codes should agree with experimental measurements. This is the summary of the joint session among working groups A, B, and D of the HI32006 Workshop on computer codes benchmarking.

NTIS

*Computer Programs; Particle Accelerators; Particle Theory; Nuclear Physics*

**20070014576** Lawrence Livermore National Lab., Livermore, CA USA

#### **LDRD Final Report Technology Basis for Fluorescence Imaging in the Nuclear Domain (FIND), Fiscal Year 2005**

Barty, C. P. J.; Feb. 15, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896592; UCRL-TR-219034; No Copyright; Avail.: Department of Energy Information Bridge

Work performed as a part of this ER sets the foundation for applications of high brightness light sources to important homeland security and nonproliferation problems. Extensive modeling has been performed with the aim to understand the



performance of a class of interrogation systems that exploit nuclear resonance fluorescence to detect specific isotopes, of particular importance for national security and industry.

NTIS

*Imaging Techniques; Image Processing; Resonance Fluorescence; Isotopes*

## 74 OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

**20070013818** Wilmer Cutler Pickering Hale and Dorr, LLP, New York, NY, USA

### **Methods and Systems for Compensating an Image Projected onto a Surface Having Spatially Varying Photometric Properties**

Nayar, S.; Grossberg, M.; Harish, P.; Belhumeur, P.; 2 Jul 04; 29 pp.; In English

Contract(s)/Grant(s): NSF-115-00-85864

Patent Info.: Filed Filed 2 Jul 04; US-Patent-Appl-SN-10-883 861

Report No.(s): PB2007-103090; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Methods and systems are provided for displaying images onto an arbitrary surface, using a projector, such that the quality of the images is preserved despite surface imperfections or color variations. Methods and systems are also provided for controlling the appearance of a projection surface. Various embodiments use a detailed radiometric model and a calibration method to determine the pixel values required to be projected by a projector in order for a camera to observe a desired image. Other embodiments use a compensation algorithm that uses a feedback approach to provide the desired image compensation. Geometric mapping may be used to establish a correspondence between points in the images to be displayed by the projector and the corresponding points in the images that are captured by the camera.

NTIS

*Display Devices; Image Processing; Photometry*

**20070013819** Townsend and Townsend and Crew, LLP, San Francisco, CA, USA, Washington Univ., Seattle, WA, USA

### **Circular Extinction Contrast Imaging Microscope**

Kaminsky, W.; Kahr, B.; 18 Oct 04; 24 pp.; In English

Contract(s)/Grant(s): NSF-CHE-0092617

Patent Info.: Filed Filed 18 Oct 04; US-Patent-Appl-SN-10-968 834

Report No.(s): PB2007-103091; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Systems and methods for producing circular extinction (CE) contrast images of anisotropic samples. Microscope systems for determining circular extinction (CE), the differential transmission of left and right circularly polarized light resulting from circular dichroism (CD) of an anisotropic sample, include mechanically driven optical components and an image detector such as a monochromatic CCD camera to detect light intensities. In one aspect, optical components include a tunable filter, a rotatable linear polarizer and a variable retarder. The tunable filter is adjustable to provide light at a specific desired wavelength. The linear polarizer is adjustable to provide linearly polarized light with a specific wave vector, and the variable retarder is adjustable to produce near perfect circular polarized light at every selected wavelength. For example, in one aspect, the variable retarder includes a linear birefringent plate tiltable around one of its eigenmodes perpendicular to the wave vector of polarized light. The plate may be controllably tilted so that it functions as a perfect  $\lambda/4$  plate at each wavelength.

NTIS

*Extinction; Imaging Techniques; Microscopes; Microscopy*

**20070013822** Christensen, OConnor, Johnson, Kindness, PLLC, Seattle, WA, USA

### **Surface Plasmon Resonance Imaging System and Method**

Chinowsky, T. M.; 25 Oct 04; 28 pp.; In English

Contract(s)/Grant(s): NIH-UO1-DE14971-02

Patent Info.: Filed Filed 25 Oct 04; US-Patent-Appl-SN-10-973 928

Report No.(s): PB2007-103093; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A surface plasmon resonance imaging system (40) and method is provided. The system (40) includes a light source (42) comprising a light-emitting diode (LED) array that is positioned at the focal point of a collimating lens (44). The light source

(42) and collimating lens (44) are used to illuminate the substrate surface (50) at a range of angles dependent upon which one or more LEDs are lit. The substrate surface (50) receives light from the collimated lens (44) at a selected incident angle, which can be varied by selective illumination of one or more of the LEDs in the LED array. The system (40) further includes a detector (60) that is positioned such that it is capable of detecting an image reflected from the substrate surface (50).

NTIS

*Imaging Techniques; Surface Plasmon Resonance; Methodology*

**20070013826** Weingarten, Schurgin, Gagnebin and Lebovici. LLP, Boston, MA, USA, Massachusetts Univ., Boston, MA, USA

**Systems and Methods for Limiting Power using Photo-induced Anisotropy**

Wu, P.; Phillip, R.; Rao, D. V.; 25 Jun 04; 16 pp.; In English

Contract(s)/Grant(s): DAAD 16-01-C-0018

Patent Info.: Filed 25 Jun 04; US-Patent-Appl-SN-10-877 777

Report No.(s): PB2007-103097; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Preferred embodiments of the present invention are directed at limiting power and controlling an output intensity of an optical system using photo-induced anisotropic materials. In a preferred embodiment, an azobenzene polymer film is used. The embodiments in accordance with the present invention include a cross-polarization system to provide clamping of the output intensity. A system for limiting power in accordance with a preferred embodiment of the present invention, includes a light source that provides an input light beam along a first optical path, a first polarizing element having a first polarization state positioned in the first optical path, a second polarizing element positioned in the first optical path having a second polarization state substantially orthogonal to the first polarization state, a sample having a photo-induced anisotropic material positioned in the first optical path, and a polarizer positioned in a second optical path at an angle of approximately 45 degrees to that of the input beam wherein an excitation beam provided in the second optical path spatially overlaps the input beam on the sample, and an output beam that is generated has a limited transmission value at high intensity.

NTIS

*Anisotropy; Lasers; Optics; Optical Polarization*

**20070014082** Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, The Hague, Netherlands

**Military Applications of Adaptive Optics**

Bekman, H. H. P.; vanPutten, F. J. M.; Fritz, P. J.; September 2006; 7 pp.; In Dutch

Contract(s)/Grant(s): A01KM769; TNO Proj. 015.31313

Report No.(s): TD2006-0093; TNO-DV 2006 A336; Copyright; Avail.: Other Sources

In this project the benefits of adaptive optics for military applications are assessed. Adaptive optics can be used in electro-optical camera systems and it can be used in laser systems such as directed infrared counter measure systems. In a WEAG project JP8.11 on Precision Laser Beam Steering the benefits of adaptive optics for long range target identification and DIRCM have been evaluated. The findings of the study group are reported in TNO report FEL-04- A102. In this project we have studied some of the questions raised in JP8.11 in more detail. The first question is for which optical detection systems adaptive optics can bring some benefits. It was concluded that only for lenses with very large focal numbers and therefore very small field of view adaptive optics can be beneficial. This is caused by the very small atmospheric 'iso-planatic' patch which is typical of the order of 1 mrad. We have also studied the influence of atmospheric or plume turbulence on the jam modulation pattern. We have found that plume turbulence levels can severely distort the jam pattern, thus increasing the break-lock time or making the jamming ineffective. This aspect will be further studied in an EDA project.

Author

*Adaptive Optics; Military Technology; Countermeasures*

**20070014589** Lawrence Livermore National Lab., Livermore, CA USA, University of Central Washington, Ellensburg, WA, USA

**Effect of Pulse Duration on Laser-Induced Damage by 1053-nm Light in Potassium Dihydrogen Phosphate Crystals**

Cross, D. A.; Braunstien, M. R.; Carr, C. W.; Dec. 10, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896598; UCRL-PROC-226687; No Copyright; Avail.: National Technical Information Service

(NTIS)

Laser induced damage in potassium dihydrogen phosphate (KDP) has previously been shown to depend significantly on

pulse duration for 351-nm Gaussian pulses. In this work we studied the properties of damage initiated by 1053-nm temporally Gaussian pulses with 10ns and 3ns FWHM durations. Our results indicate that the number of damage sites induced by 1053-nm light scales with pulse duration ( $\tau$ ) as  $(\tau(\text{sub } 1)/\tau(\text{sub } 2))^{0.17}$  in contrast to the previously reported results for 351-nm light as  $(\tau(\text{sub } 1)/\tau(\text{sub } 2))^{0.35}$ . This indicates that damage site formation is significantly less probable at longer wavelengths for a given fluence.

NTIS

*Damage; Lasers; Potassium Phosphates; Pulse Duration; Crystals*

**20070014590** Lawrence Livermore National Lab., Livermore, CA USA, Case Western Reserve Univ., Cleveland, OH USA  
**First X-Ray Fluorescence MicroCT Results from Micrometeorites at SSRL**

Ignatyew, K.; Huwig, K.; Harvey, R.; Ishii, H. A.; Bradley, J. P.; Aug. 23, 2006; 6 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896600; UCRL-PROC-224033; No Copyright; Avail.: National Technical Information Service (NTIS)

X-ray fluorescence microCT (computed tomography) is a novel technique that allows non-destructive determination of the 3D distribution of chemical elements inside a sample. This is especially important in samples for which sectioning is undesirable either due to the risk of contamination or the requirement for further analysis by different characterization techniques. Developments made by third generation synchrotron facilities and laboratory X-ray focusing systems have made these kinds of measurements more attractive by significantly reducing scan times and beam size. First results from the x-ray fluorescence microCT experiments performed at SSRL beamline 6-2 are reported here. Beamline 6-2 is a 54 pole wiggler that uses a two mirror optical system for focusing the x-rays onto a virtual source slit which is then reimaged with a set of KB mirrors to a  $(2 \times 4)$  (micro)<sup>2</sup> beam spot. An energy dispersive fluorescence detector is located in plane at 90 degrees to the incident beam to reduce the scattering contribution. A PIN diode located behind the sample simultaneously measures the x-ray attenuation in the sample. Several porous micrometeorite samples were measured and the reconstructed element density distribution including self-absorption correction is presented. Ultimately, this system will be used to analyze particles from the coma of comet Wild-2 and fresh interstellar dust particles both of which were collected during the NASA Stardust mission.

NTIS

*Micrometeorites; X Ray Fluorescence; Chemical Composition; Computer Aided Tomography*

**20070014723** Lawrence Livermore National Lab., Livermore, CA USA

**Short-Pulse Laser Capability on the Mercury Laser System**

Utterback, E.; Thelin, P.; Ebberts, C.; Armstrong, P.; Barly, P. J.; Jun. 22, 2006; 5 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896587; UCRL-CONF-222445; No Copyright; Avail.: National Technical Information Service (NTIS)

Applications using high energy 'petawatt-class' laser drivers operating at repetition rates beyond 0.01 Hz are only now being envisioned. The Mercury laser system is designed to operate at 100 J/pulse at 10 Hz. We investigate the potential of configuring the Mercury laser to produce a rep-rated, 'petawatt-class' source. The Mercury laser is a prototype of a high energy, high repetition rate source (100 J, 10 Hz). The design of the Mercury laser is based on the ability to scale in energy through scaling in aperture. Mercury is one of several 100 J, high repetition rate (10 Hz) lasers sources currently under development (HALNA, LUCIA, POLARIS). We examine the possibility of using Mercury as a pump source for a high irradiance 'petawatt-class' source: either as a pump laser for an average power Ti:Sapphire laser, or as a pump laser for OPCPA based on  $\text{YCa}(\text{sub } 4)\text{O}(\text{BO}(\text{sub } 3))(\text{sub } 3)$  (YCOB), ideally producing a source approaching 30 J /30 fs /10 Hz--a high repetition rate petawatt.

NTIS

*Lasers; Pulsed Lasers*

**20070014728** Lawrence Livermore National Lab., Livermore, CA USA

**New Expedited Approach to Evaluate the Importance of Different Crystal Growth Parameters on Laser Damage Performance in KDP and DKDP**

Negres, R. A.; Zaitseva, N. P.; DeMange, P.; Demos, S. G.; Nov. 01, 2006; 7 pp.; In English

Report No.(s): DE2006-896619; UCRL-PROC-225780; No Copyright; Avail.: Department of Energy Information Bridge

In this work, we investigate the laser-induced damage resistance at 355 nm in DKDP crystals grown with varying growth

parameters, including temperature, speed of growth and impurity concentration. In order to perform this work, a DKDP crystal was grown over 34 days by the rapid-growth technique with varied growth conditions. By using the same crystal, we are able to isolate growth-related parameters affecting LID from raw material or other variations that are encountered when testing in different crystals. The objective is to find correlations of damage performance to growth conditions and reveal the key parameters for achieving DKDP material in which the number of damage initiating defects is reduced. This approach can lead to reliable and expedite information regarding the importance of different crystal growth parameters on the laser damage characteristics of these crystals.

NTIS

*Crystal Growth; Defects; Laser Damage; Lasers*

**20070014742** Daresbury Nuclear Physics Lab., UK, Cornell Univ., Ithaca, NY, USA, Brookhaven National Lab., Upton, NY USA

#### **Optic Issues in Ongoing ERL Projects**

Smith, S. L.; Muratori, B. D.; Owen, H. L.; Hoffstaetter, G. H.; January 2006; 75 pp.; In English

Report No.(s): DE2007-892520; FERMILAB-CONF-05-633-AD; No Copyright; Avail.: National Technical Information Service (NTIS)

A wide range of optics issues for Energy Recovery Linac (ERL) based projects are illustrated through the presentation of ongoing projects covering both light sources, at Cornell and Daresbury and high energy and nuclear physics accelerators at the Brookhaven National Laboratory. This presented range of projects demonstrates how the different design teams see the challenges of studying and solving optics issues for their particular projects ERLs, with studies appropriate to the stage of maturity of the project. Finally as an illustration of the complexity and detail behind a single aspect of ERL optics design we present an overview of the highly important generic topic of longitudinal phase space evolution in ERLs.

NTIS

*Electron Beams; Linear Accelerators; Light Sources; Optics*

## 75

### PLASMA PHYSICS

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

**20070013788** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Effect of EMIC Wave Normal Angle Distribution on Relativistic Electron Scattering**

Gamayunov, K. V.; Khazanov, G. V.; December 15, 2006; 1 pp.; In English; 2006 Fall American Geophysical Union Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The flux level of outer-zone relativistic electrons (above 1 MeV) is extremely variable during geomagnetic storms, and controlled by a competition between acceleration and loss. Precipitation of these electrons due to resonant pitch-angle scattering by electromagnetic ion cyclotron (EMIC) waves is considered one of the major loss mechanisms. This mechanism was suggested in early theoretical studies more than three decades ago. However, direct experimental evidence of the wave role in relativistic electrons precipitation is difficult to obtain because of lack of concurrent measurements of precipitating electrons at low altitudes and the waves in a magnetically conjugate equatorial region. Recently, the data from balloon-borne X-ray instruments provided indirect but strong evidence on an efficiency of the EMIC wave induced loss for the outer-zone relativistic electrons. These observations stimulated theoretical studies that, particularly, demonstrated that EMIC wave induced pitch-angle diffusion of MeV electrons can operate in the strong diffusion limit and this mechanism can compete with relativistic electron depletion caused by the Dst effect during the initial and main phases of storm. Although an effectiveness of relativistic electron scattering by EMIC waves depends strongly on the wave spectral properties, the most favorable assumptions regarding wave characteristics has been made in all previous theoretical studies. Particularly, only quasi field-aligned EMIC waves have been considered as a driver for relativistic electron loss. At the same time, there is growing experimental and theoretical evidence that these waves can be highly oblique; EMIC wave energy can occupy not only the region of generation, i.e. the region of small wave normal angles, but also the entire wave normal angle region, and even only the region near 90 degrees. The latter can dramatically change the effectiveness of relativistic electron scattering by EMIC waves. In the present study, we calculate the pitch-angle diffusion coefficients using the typical wave normal distributions

obtained from our self-consistent ring current-EMIC wave model, and try to quantify the effect of EMIC wave normal angle characteristics on relativistic electron scattering.

Author

*Angular Distribution; Electromagnetic Radiation; Relativistic Particles; High Energy Electrons; Electron Scattering*

**20070013877** Gates and Cooper, Los Angeles, CA, USA

**Remote Plasma Deposition of Thin Films**

Babayan, S. E.; Hicks, R. F.; 5 Nov 04; 27 pp.; In English

Contract(s)/Grant(s): DE-F5607-96ER-45621

Patent Info.: Filed 5 Nov 04; US-Patent-Appl-SN-10-982 122

Report No.(s): PB2007-102472; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The invention is related to plasma devices or reactors that are used for cleaning, sterilization, surface activation, etching, and thin-film deposition, and in particular to a low-temperature compatible, wide-pressure-range plasma flow device.

NTIS

*Plasmas (Physics); Thin Films; Vapor Deposition*

**20070014702** Lawrence Livermore National Lab., Livermore, CA USA

**Spheromak Buildup in SSPX using a Modular Capacitor Bank**

Wood, R. D.; McLean, H. S.; Hill, D. N.; Hooper, E. B.; Romero-Talamas, C. A.; Jun. 13, 2006; 6 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896568; UCRL-CONF-222117; No Copyright; Avail.: Department of Energy Information Bridge

The Sustained Spheromak Physics Experiment (SSPX) was designed to address both magnetic field generation and confinement. The SSPX produces 1.5-3.5msec, spheromak plasmas with a 0.33m major radius and a minor radius of (approx.) 0.23m. DC coaxial helicity injection is used to build and sustain the spheromak plasma within the flux conserver. Optimal operation is obtained by flattening the profile of  $(\lambda) = (\mu)_{j/B}$ , consistent with reducing the drive for tearing and other MHD modes, and matching of edge current and bias flux to minimize  $(\Delta)B/B_{(sub\ rms)}$ . With these optimizations, spheromak plasmas with central  $T_{(sub\ e)} \approx 350\text{eV}$  and  $(\beta)_{(sub\ e)}$  (approx.) 5% with toroidal fields of 0.6T have been obtained. If a favorable balance between current drive efficiency and energy confinement can be shown, the spheromak has the potential to yield an attractive magnetic fusion concept.

NTIS

*Capacitors; Magnetic Fields; Spheromaks*

**20070014722** Lawrence Livermore National Lab., Livermore, CA USA, Gulf General Atomic, San Diego, CA, USA

**Analysis and Modeling of DIII-D Hybrid Discharges and Their Extrapolation to ITER**

Makowski, M. A.; Casper, T. A.; Jayakumar, R. J.; Pearlstein, L. D.; Petty, C. C.; Jun. 16, 2006; 6 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896584; UCRL-CONF-222187; No Copyright; Avail.: National Technical Information Service (NTIS)

Recent experiments on tokamaks around the world have demonstrated discharges with moderately high performance in which the q-profile remains stationary, as measured by the motional Stark effect diagnostic, for periods up to several  $(\tau)_{(sub\ R)}$ . Hybrid discharges are characterized by  $q_{(sub\ min)}$  (approx.) 1, high  $(\beta)_{(sub\ N)}$ , and good confinement. These discharges have been termed hybrid because of their intermediate nature between that of an ordinary H-mode and advanced tokamak discharges. They form an attractive scenario for ITER as the normalized fusion performance  $((\beta)_{(sub\ N)}H_{(sub\ 89P)}/q_{(sub\ 95)}^{(sup\ 2)})$  is at or above that for the ITER baseline  $Q_{(sub\ fus)} = 10$  scenario, even for  $q_{(sub\ 95)}$  as high as 4.6. The startup phase is thought to be crucial to the ultimate evolution of the hybrid discharge. An open question is how hybrid discharges achieve and maintain their stationary state during the initial startup phase. To investigate this aspect of hybrid discharges, we have used the CORSICA code to model the early stages of a discharge. Results clearly indicate that neoclassical current evolution alone is insufficient to account for the time evolution of the q-profile and that an addition of non-inductive current source must be incorporated into the model to reproduce the experimental time history. We include non-inductive neutral beam and bootstrap current sources in the model, and investigate the difference between simulations with these sources and the experimentally inferred q-profile.

NTIS

*Extrapolation; Fusion Reactors; Thermonuclear Reactions*



## 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*.

**20070013799** Calabazas Creek Research, Inc., San Mateo, CA, USA

**Doubly Convergent Fundamental Mode MBK Final Report**

Oct. 27, 2006; 10 pp.; In English

Contract(s)/Grant(s): DE-FG02-05ER84349

Report No.(s): DE2006-895123; No Copyright; Avail.: National Technical Information Service (NTIS)

Calabazas Creek Research, Inc. (CCR) proposed to develop a compact, inexpensive, fundamental mode, multiple beam klystron (MBK) at 1.3 GHz for driving a superconducting accelerator. The goal was to incorporate a doubly convergent multiple beam gun and enable a new generation of distributed beam devices. The proposed klystron requirements for targeted toward the TESLA collider.

NTIS

*Convergence; Plasma Physics; Superconductivity*

**20070013801** Stanford Linear Accelerator Center, CA, USA, London Univ., UK

**Super Flavor Factory**

Bevan, A. J.; Nov. 2006; 6 pp.; In English

Report No.(s): DE2006-895257; SLAC-PUB-12202; No Copyright; Avail.: National Technical Information Service (NTIS)

The main physics goals of a high luminosity  $e(\text{sup } +)e(\text{sup } -)$  flavor factory are discussed, including the possibilities to perform detailed studies of the CKM mechanism of quark mixing, and constrain virtual Higgs and Non-Standard Model particle contributions to the dynamics of rare  $B(\text{sub } u,d,s)$  decays. The large samples of D mesons and ( $\tau$ ) leptons produced at a flavor factory will result in improved sensitivities on D mixing and lepton flavor violation searches, respectively. One can also test fundamental concepts such as lepton universality to much greater precision than existing constraints and improve the precision on tests of CPT from B meson decays. Recent developments in accelerator physics have demonstrated the feasibility to build an accelerator that can achieve luminosities of  $(\text{Omicron})(10(\text{sup } 36) \text{ cm}(\text{sup } -2) \text{ s}(\text{sup } -1))$ .

NTIS

*Industrial Plants; Luminosity; Particle Accelerators*

**20070013803** Stanford Linear Accelerator Center, CA, USA, Argonne National Lab., IL USA

**RF Design of an HOM Polarized RF Gun for the ILC**

Wang, J. W.; Clendenin, J. E.; Colby, E. R.; Miller, R. A.; Lewellen, J. W.; Nov. 2006; 3 pp.; In English

Report No.(s): DE2006-895262; SLAC-PUB-12190; No Copyright; Avail.: National Technical Information Service (NTIS)

The ILC requires a polarized electron beam. While a highly polarized beam can be produced by a GaAs-type cathode in a DC gun of the type currently in use at SLAC, JLAB and elsewhere, the ILC injector system can be simplified and made more efficient if a GaAs-type cathode can be combined with a low emittance RF gun. Since this type of cathode is known to be extremely sensitive to vacuum contamination including back bombardment by electrons and ions, any successful polarized RF gun must have a significantly improved operating vacuum compared to existing RF guns. We present a new RF design for an L-Band normal conducting (NC) RF gun for the ILC polarized electron source. This design incorporates a higher order mode (HOM) structure, whose chief virtue in this application is an improved conductance for vacuum pumping on the cathode. Computer simulation models have been used to optimize the RF parameters with two principal goals: first to minimize the required RF power; second to reduce the peak surface field relative to the field at the cathode in order to suppress field emitted electron bombardment. The beam properties have been simulated initially using PARMELA. Vacuum and other practical issues for implementing this design are discussed.

NTIS

*Electron Beams; Linear Accelerators; Particle Accelerators; Radio Frequencies*

**20070013820** Barcelona Univ., Spain, Bari Univ., Italy, Academia Sinica, Beijing, China, Bergen Univ., Norway

**Observation of an Excited Charm Baryon  $\Omega(\text{sup } *)\text{sub } (c)$  Decaying to  $\Omega(\text{sup } O)\text{sub } (c)$  Gamma**

Aubert, B.; Bona, M.; Boutigny, D.; Couderc, F.; Karyotakis, Y.; Dec. 2000; 7 pp.; In English

Report No.(s): DE2006-895268; SLAC-PUB-12075; No Copyright; Avail.: National Technical Information Service (NTIS)

The authors report the first observation of an excited singly-charmed baryon ( $\Omega^*(\text{sub } c)$ ) ( $\text{css}$ ) in the radiative decay ( $\Omega(\text{sub } c)(\text{sup } 0)(\text{gamma})$ ), where the ( $\Omega(\text{sub } c)(\text{sup } 0)$ ) baryon is reconstructed in the decays to the final states ( $\Omega(\text{sup } -)(\text{pi})(\text{sup } +)$ ), ( $\Omega(\text{sup } -)(\text{pi})(\text{sup } +)(\text{pi})(\text{sup } 0)$ ), ( $\Omega(\text{sup } -)(\text{pi})(\text{sup } +)(\text{pi})(\text{sup } -)(\text{pi})(\text{sup } +)$ ), and ( $\Xi(\text{sup } -)K(\text{sup } -)(\text{pi})(\text{sup } +)(\text{pi})(\text{sup } +)$ ). This analysis is performed using a dataset of 230.7 fb(<sup>-1</sup>) collected by the BABAR detector at the PEP-II asymmetric-energy B Factory at the Stanford Linear Accelerator Center. The mass difference between the ( $\Omega_0(\text{sub } c)$ ) and the ( $\Omega(\text{sub } c)(\text{sup } 0)$ ) baryons is measured to be 70.8 (+-) 1.0(stat) (+-) 1.1(syst) MeV/c(<sup>2</sup>). They also measure the ratio of inclusive production cross sections of ( $\Omega_0(\text{sub } c)$ ) and ( $\Omega(\text{sub } c)(\text{sup } 0)$ ) in  $e(\text{sup } +)e(\text{sup } -)$  annihilation.

NTIS

*Annihilation Reactions; Baryons; Particle Accelerators*

**20070013833** California Univ., San Diego, La Jolla, CA, USA

**Turning of Hidden Order and Superconductivity in URu(sub)Si(sub 2) by Applied Pressure and Re Substitution**

Butch, N. P.; Jeffries, J. R.; Yukich, B. T.; Maple, M. B.; January 2006; 6 pp.; In English

Report No.(s): DE2006-895363; No Copyright; Avail.: National Technical Information Service (NTIS)

Single crystals of URu<sub>2-x</sub>Re<sub>x</sub>Si<sub>2</sub> have been grown via the Czochralski technique. Detailed electrical transport studies under pressure on single crystals of URu<sub>2</sub>Si<sub>2</sub> confirm that the zero- temperature critical field is suppressed smoothly towards an extrapolated critical pressure of 15 kbar, which also corresponds to the accepted critical pressure of the hidden order phase. Improving on previous work on polycrystalline samples, studies of single crystals of URu<sub>2-x</sub>Re<sub>x</sub>Si<sub>2</sub> have provided more precise tracking of the suppression of both the hidden order phase at low doping and the ferromagnetic phase at intermediate Re concentrations.

NTIS

*Crystals; Ruthenium; Silicides; Substitutes; Superconductivity; Uranium; Uranium Compounds*

**20070013840** Argonne National Lab., IL USA, Stanford Linear Accelerator Center, CA, USA

**LC HCAL Absorber and Active Media Comparisons using a Particle-Flow Algorithm**

Magill, S.; Kuhlmann, S.; January 2006; 5 pp.; In English

Report No.(s): DE2006-895277; SLAC-PUB-12203; No Copyright; Avail.: National Technical Information Service (NTIS)

We compared Stainless Steel (SS) to Tungsten (W) as absorber for the HCAL in simulation using single particles (pions) and a Particle-Flow Algorithm applied to  $e(\text{sup } +)e(\text{sup } -)$   $-\text{g } Z$   $-\text{g } \text{qqbar}$  events. We then used the PFA to evaluate the performance characteristics of a LC HCAL using W absorber and comparing scintillator and RPC as active media. The W/Scintillator HCAL performs better than the SS/Scintillator version due to finer ( $\lambda(\text{sub } I)$ ) sampling and narrower showers in the dense absorber. The W/Scintillator HCAL performs better than the W/RPC HCAL except in the number of unused hits in the PFA. Since this represents the confusion term in the PFA response, additional tuning and optimization of a W/RPC HCAL might significantly improve this HCAL configuration.

NTIS

*Algorithms; Particle Accelerators; Stainless Steels; Tungsten*

**20070013875** Brookhaven National Lab., Upton, NY USA

**Parallel 3-D Space Charge Calculations in the Unified Accelerator Library**

D'Imperio, N. L.; Luccio, A. U.; Boine, O.; Malitsky, N.; Jun. 30, 2006; 5 pp.; In English

Report No.(s): DE2006-896446; BNL-77076-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

The paper presents the integration of the SIMBAD space charge module in the UAL framework. SIMBAD is a Particle-in-Cell (PIC) code. Its 3-D Parallel approach features an optimized load balancing scheme based on a genetic algorithm. The UAL framework enhances the SIMBAD standalone version with the interactive ROOT-based analysis environment and an open catalog of accelerator algorithms. The composite package addresses complex high intensity beam dynamics and has been developed as part of the FAIR SIS 100 project.

NTIS

*Particle Accelerators; Space Charge; Three Dimensional Models*

**20070013917** Stanford Linear Accelerator Center, CA, USA, European Synchrotron Radiation Facility, Grenoble, France, Stanford Univ., CA, USA, Stanford Univ., CA, USA

**EXAFS Signatures of Structural Zn at Trace Levels in Layered Minerals**

Juillot, F.; Morin, G.; Haxemann, J. L.; Proux, O.; Belin, S.; Nov. 01, 2006; 3 pp.; In English

Report No.(s): DE2006-896407; SLAC-PUB-12227; No Copyright; Avail.: National Technical Information Service (NTIS)

Many in situ XAFS studies have shown that zinc incorporated in layered minerals is a major form of zinc in Zn-contaminated soils. Quantitative information on the local structural environment(s) and ordering of Zn in these minerals is required to better understand its behavior in soils. In this study, EXAFS spectroscopy was used to assess the structural environment of zinc incorporated at trace levels (40 ppm to 4,000 ppm) within the octahedral sheets of various natural and synthetic layered minerals. Results indicate that EXAFS data analyzed using ab initio FEFF calculations (FEFF 8.10) can unambiguously distinguish between zinc incorporation within the octahedral sheet of dioctahedral versus trioctahedral layered minerals and can determine the distribution (random or ordered) of zinc cations within the octahedral sheets of these minerals.

NTIS

*Minerals; Signatures; Soils; X Ray Spectroscopy; Zinc*

**20070013927** Brookhaven National Lab., Upton, NY USA

**Computer Science Center, 2006**

2006; 68 pp.; In English

Report No.(s): DE2006-895559; BN-72286-2006; No Copyright; Avail.: Department of Energy Information Bridge

Computational Science is an integral component of Brookhaven's multi science mission, and is a reflection of the increased role of computation across all of science. Brookhaven currently has major efforts in data storage and analysis for the Relativistic Heavy Ion Collider (RHIC) and the ATLAS detector at CERN, and in quantum chromodynamics. The Laboratory is host for the QCDOC machines (quantum chromodynamics on a chip), 10 teraflop/s computers which boast 12,288 processors each. There are two here, one for the Riken/BNL Research Center and the other supported by DOE for the US Lattice Gauge Community and other scientific users. A 100 teraflop/s supercomputer will be installed at Brookhaven in the coming year, managed jointly by Brookhaven and Stony Brook, and funded by a grant from New York State. This machine will be used for computational science across Brookhaven's entire research program, and also by researchers at Stony Brook and across New York State. With Stony Brook, Brookhaven has formed the New York Center for Computational Science (NYCCS) as a focal point for interdisciplinary computational science, which is closely linked to Brookhaven's Computational Science Center (CSC). The CSC has established a strong program in computational science, with an emphasis on nanoscale electronic structure and molecular dynamics, accelerator design, computational fluid dynamics, medical imaging, parallel computing and numerical algorithms. We have been an active participant in DOES SciDAC program (Scientific Discovery through Advanced Computing). We are also planning a major expansion in computational biology in keeping with Laboratory initiatives. Additional laboratory initiatives with a dependence on a high level of computation include the development of hydrodynamics models for the interpretation of RHIC data, computational models for the atmospheric transport of aerosols, and models for combustion and for energy utilization.

NTIS

*Particle Accelerators; Supercomputers*

**20070013929** OMEGA-P, Inc., New Haven, CT, USA

**20-MW Magnicon for ILC**

Nov. 2006; 25 pp.; In English

Contract(s)/Grant(s): DE-FG02-05ER-84396

Report No.(s): DE2006-895656; No Copyright; Avail.: National Technical Information Service (NTIS)

The 1.3 GHz RF power to drive ILC is now planned to be supplied by 600-1200, 10-MW peak power multi-beam klystrons. In this project, a conceptual design for 1.3 GHz magnicons with 20 MW peak power was developed as an alternative to the klystrons, with the possibility of cutting in half the numbers of high-power tubes and associated components. Design of a conventional magnicon is described, using TM110 modes in all cavities, as well as design of a modified magnicon with a TE111 mode output cavity. The latter has the advantage of much lower surface fields than the TM110 mode, with no loss of output power or electronic efficiency.

NTIS

*Particle Accelerators; Power Efficiency*

**20070013935** California Univ., Santa Barbara, CA, USA

**Microstructure and Mechanics of Superconductor Epitaxy via the Chemical Solution Deposition Method. Report for September 1, 2003 to December 31, 2006**

Nov. 2006; 16 pp.; In English

Contract(s)/Grant(s): DE-FC07-031D14511

Report No.(s): DE2006-895676; No Copyright; Avail.: Department of Energy Information Bridge

Initially the funds were sufficient funds were awarded to support one graduate student and one post-doc. Lange, though other funds, also supported a graduate intern from ETH Zurich, Switzerland for a period of 6 months. The initial direction was to study the chemical solution deposition method to understand the microstructural and mechanical phenomena that currently limit the production of thick film, reliable superconductor wires. The study was focused on producing thicker buffer layer(s) on Ni-alloy substrates produced by the RABiTS method. It focused on the development of the microstructure during epitaxy, and the mechanical phenomena that produce cracks during dip-coating, pyrolysis (decomposition of precursors during heating), crystallization and epitaxy. The initial direction of producing thicker layers of a known buffer layer material was redirected by co-workers at ORNL, in an attempt to epitaxially synthesize a potential buffer layer material, LaMnO<sub>3</sub>, via the solution route. After a more than a period of 6 months that showed that the LaMnO<sub>3</sub> reacted with the Ni-W substrate at temperatures that could produce epitaxy, reviewers at the annual program review strongly recommended that the research was not yielding positive results. The only positive result presented at the meeting was that much thicker films could be produced by incorporating a polymer into the precursor that appeared to increase the precursors resistance to crack growth. Thus, to continue the program, the objectives were changed to find compositions with the perovskite structure that would be chemically compatible with either the Ni-W RABiTS or the MgO IBAD Ni-alloy substrates, and produce a better lattice parameter fit between either of the two substrates. At the start of the second year, the funding was reduced to 2/3s of the first year level, which required the termination of the post-doc after approximately 5 months into the second year. From then on, further funding was intermittent to say the least, and funding to support the student and the research expenses has to be supplemented by Langes gift funds. During the first part of the second year, strontium zirconate was identified as an alternative to lanthanum manganite as a buffer layer for use on the IBAD MgO superconducting wire. A lattice parameter of 4.101 Angstroms offers a reduced lattice mismatch between the MgO and SrZrO<sub>3</sub>. Studies were focused on investigating hybrid precursor routes, combining Sr acetate with a number of different Zr alkoxides.

NTIS

*Chemical Analysis; Deposition; Epitaxy; High Temperature Superconductors; Microstructure; Superconducting Films; Superconductors (Materials)*

**20070013940** Brookhaven National Lab., Upton, NY USA

#### **CSNS LINAC Design**

Fu, S.; Fang, S.; Wei, J.; Aug. 01, 2006; 7 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-896440; BNL-77068-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

China Spallation Neutron Source has been approved in principle by the Chinese government. CSNS can provide a beam power of 100kW on the target in the first phase, and then 200kW in the second phase. The accelerator complex of CSNS consists of an H- linac of 81MeV and a rapid cycling synchrotron of 1.6GeV at 25Hz repetition rate. In the second phase, the linac energy will be upgraded to 132MeV and the average current will be doubled. The linac has been designed, and some R&D studies have started under the support from Chinese Academy of Sciences. The linac comprises a H- ion source, an RFQ and a conventional DTL with EMQs. This paper will present our major design results and some progresses in the R&D of the linac.

NTIS

*China; Linear Accelerators; Neutron Sources; Particle Accelerators; Spallation*

**20070013941** Brookhaven National Lab., Upton, NY USA

#### **Fiddling Carbon Strings with Polarized Proton Beams**

Huang, H.; Kurita, K.; May 01, 2006; 21 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-896442; BNL-77070-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

An innovative polarimeter based on proton carbon elastic scattering in the Coulomb Nuclear Interference (CNI) region was first tested in the Brookhaven AGS successfully. CNI Polarimeters were then installed in the AGS and both RHIC rings. The polarimeter consists of ultra-thin carbon targets and silicon strip detectors. The waveform digitizers are used for signal readout, which allows deadtime-less data processing on the fly. Polarimeters are crucial instrumentation for the RHIC spin physics program. This paper summarizes the polarimeter design issues and operation results.

NTIS

*Carbon; Particle Accelerators; Polarimeters; Proton Beams; Strings*

**20070013943** Brookhaven National Lab., Upton, NY USA

**Simulation Results of Running the AGS MMPS, by Storing Energy in Capacitor Banks**

Marneris, I.; Sep. 01, 2006; 11 pp.; In English

Report No.(s): DE2006-896443; BNL-77073-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge

The Brookhaven AGS is a strong focusing accelerator which is used to accelerate protons and various heavy ion species to equivalent maximum proton energy of 29 GeV. The AGS Main Magnet Power Supply (MMPS) is a thyristor control supply rated at 5500 Amps, +/-5000 Volts. The peak magnet power is 49.5 Mwatts. The power supply is fed from a motor/generator manufactured by Siemens. The motor is rated at 9 MW, input voltage 3 phase 13.8 KV 60 Hz. The generator is rated at 50 MVA its output voltage is 3 phase 7500 Volts. Thus the peak power requirements come from the stored energy in the rotor of the motor/generator. The rotor changes speed by about +/-2.5% of its nominal speed of 1200 Revolutions per Minute. The reason the power supply is powered by the Generator is that the local power company (LIPA) can not sustain power swings of +/- 50 MW in 0.5 sec if the power supply were to be interfaced directly with the AC lines. The Motor Generator is about 45 years old and Siemens is not manufacturing similar machines in the future. As a result we are looking at different ways of storing energy and being able to utilize it for our application. This paper will present simulations of a power supply where energy is stored in capacitor banks. The simulation program used is called PSIM Version 6.1. The control system of the power supply will also be presented. The average power from LIPA into the power supply will be kept constant during the pulsing of the magnets at +/-50 MW. The reactive power will also be kept constant below 1.5 MVAR. Waveforms will be presented.

NTIS

*Capacitors; Heavy Ions; Linear Accelerators; Particle Accelerators; Simulation; Power Supplies*

**20070013944** OMEGA-P, Inc., New Haven, CT, USA

**High-Power Ka-Band Window and Resonant Ring**

Nov. 2006; 25 pp.; In English

Contract(s)/Grant(s): DE-FG02-05ER-84395

Report No.(s): DE2006-895637; No Copyright; Avail.: National Technical Information Service (NTIS)

A stand-alone 200 MW rf test station is needed for carrying out development of accelerator structures and components for a future high-gradient multi-TeV collider, such as CLIC. A high-power rf window is needed to isolate the test station from a structure element under test. This project aimed to develop such a window for use at a frequency in the range 30-35 GHz, and to also develop a high-power resonant ring for testing the window. During Phase I, successful conceptual designs were completed for the window and the resonant ring, and cold tests of each were carried out that confirmed the designs.

NTIS

*Extremely High Frequencies; Particle Accelerators; Resonators*

**20070013946** Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

**Future Spin Physics at JLab 12 GeV and Beyond**

de Jager, K.; January 2005; 6 pp.; In English

Report No.(s): DE2006-895544; No Copyright; Avail.: Department of Energy Information Bridge

The project to upgrade the CEBAF accelerator at Jefferson Lab to 12 GeV is presented. Most of the research program supporting that upgrade, will require a highly polarized beam, as will be illustrated by a few selected examples. To carry out that research program will require an extensively upgraded instrumentation in two of the existing experimental halls and the addition of a fourth hall. The plans for a high-luminosity electron-ion collider are briefly discussed.

NTIS

*Particle Accelerators; Luminosity*

**20070013947** Brookhaven National Lab., Upton, NY, USA, Brookhaven National Lab., Upton, NY USA

**Photoemission as a Probe of the Collective Excitations in Condensed Matter Systems**

Johnson, P. D.; Valla, T.; Jul. 01, 2006; 37 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-896439; BNL-76947-2006-BC; No Copyright; Avail.: Department of Energy Information Bridge

New developments in instrumentation have recently allowed photoemission measurements to be performed with very high energy and momentum resolution.(1) This has allowed detailed studies of the self-energy corrections to the lifetime and mass renormalization of excitations in the vicinity of the Fermi level. These developments come at an opportune time. Indeed the discovery of high temperature superconductivity in the cuprates and related systems is presenting a range of challenges



for condensed matter physics.(2) Does the mechanism of high  $T_c$  superconductivity represent new physics. Do we need to go beyond Landau's concept of the Fermi liquid.(3) What, if any, is the evidence for the presence or absence of quasiparticles in the excitation spectra of these complex oxides. The energy resolution of the new instruments is comparable to or better than the energy or temperature scale of superconductivity and the energy of many collective excitations. As such, photoemission has again become recognized as an important probe of condensed matter. Studies of the high  $T_c$  superconductors and related materials are aided by the observation that they are two dimensional. To understand this, we note that the photoemission process results in both an excited photoelectron and a photohole in the final state. Thus the experimentally measured photoemission peak is broadened to a width reflecting contributions from both the finite lifetime of the photohole and the momentum broadening of the outgoing photoelectron.

NTIS

*Condensed Matter Physics; Photoelectric Emission; Elementary Excitations; Solid State Physics*

**20070013951** Stanford Linear Accelerator Center, CA, USA

#### **Development of a Focusing DIRC**

Benitez, J.; Bedajane, I.; Leith, D. W. G. S.; Mazaheri, G.; Ratcliff, R.; Nov. 01, 2006; 11 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-896419; SLAC-PUB-12236; No Copyright; Avail.: National Technical Information Service (NTIS)

Benefiting from the recent introduction of new fast vacuum-based photon detectors with a transit time spread of  $(\sigma)_{\text{sub TTS}}$  (approx) 30-150 ps, we are developing a novel RICH detector capable of correcting the chromatic error through good time measurements; we believe that this is the first time such a technique has been demonstrated. We have built and successfully tested a particle identification detector called 'Focusing DIRC'. The concept of the prototype is based on the BaBar DIRC, with several important improvements: (a) much faster pixelated photon detectors based on Burle MCP-PMTs and Hamamatsu MaPMTs, (b) a focusing mirror which allows the photon detector to be smaller and less sensitive to background in future applications, (c) electronics allowing the measurement of single photon timing to better than  $(\sigma)$  (approx) 100-200ps, which allows a correction of the chromatic error. The detector was tested in a SLAC 10GeV/c electron test beam. This detector concept could be used for particle identification at Super B-factory, ILC, GlueX, Panda, etc.

NTIS

*Electrons; Particle Accelerators; Photons; Radiation Counters*

**20070013952** Stanford Linear Accelerator Center, CA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

#### **Development of a 2D Vlasov Solver for Longitudinal Beam Dynamics in Single-Pass Systems**

Venturini, M.; Warnock, R.; Zholents, A.; Jun. 01, 2006; 26 pp.; In English

Report No.(s): DE2006-896420; SLAC-PUB-12169; No Copyright; Avail.: National Technical Information Service (NTIS)

Direct numerical methods for solving the Vlasov equation offer some advantages over macroparticle simulations, as they do not suffer from the numerical noise inherent in using a number of macroparticles smaller than the bunch population. Unfortunately these methods are more time-consuming and generally considered impractical in a full 6D phase space. However, in a lower-dimension phase space they may become attractive if the beam dynamics is sensitive to the presence of small charge-density fluctuations and a high resolution is needed. In this paper we present a 2D Vlasov solver for studying the longitudinal beam dynamics in single-pass systems of interest for X-FEL's, where characterization of the microbunching instability is of particular relevance. The solver includes a model to account for the smearing effect of a finite horizontal emittance on microbunching. We explore the effect of space charge and coherent synchrotron radiation (CSR). The numerical solutions are compared with results from linear theory and good agreement is found in the regime where linear theory applies.

NTIS

*Boltzmann-Vlasov Equation; Density (Number/Volume); Electric Charge; Particle Accelerators*

**20070013953** Brookhaven National Lab., Upton, NY USA

#### **TRANFT Users Manual**

Blaskiewicz, M.; Aug. 01, 2006; 10 pp.; In English

Report No.(s): DE2006-896444; BNL-77074-2006-IR; No Copyright; Avail.: Department of Energy Information Bridge

The Fortran program TRANFT simulates transverse instabilities in circular accelerators using fast Fourier transform algorithms. It may be used for any particle type. Forces from transverse wakefields, longitudinal wakefields, and transverse

detuning wakes are included, with linear transverse space charge forces included as a special case. This note describes the algorithms and their implementation in TRANFT.

NTIS

*Applications Programs (Computers); Computer Programs; FORTRAN; Particle Accelerators; Stability; User Manuals (Computer Programs)*

**20070013955** Stanford Linear Accelerator Center, Menlo Park, CA, USA

### **High Availability Electronics Standards**

Larsen, R. S.; Nov. 01, 2006; 7 pp.; In English

Contract(s)/Grant(s): DE-AC03-76SF00515

Report No.(s): DE2006-896413; SLAC-PUB-12144; No Copyright; Avail.: National Technical Information Service (NTIS)

Availability modeling of the proposed International Linear Collider (ILC) predicts unacceptably low uptime with current electronics systems designs. High Availability (HA) analysis is being used as a guideline for all major machine systems including sources, utilities, cryogenics, magnets, power supplies, instrumentation and controls. R&D teams are seeking to achieve total machine high availability with nominal impact on system cost. The focus of this paper is the investigation of commercial standard HA architectures and packaging for Accelerator Controls and Instrumentation. Application of HA design principles to power systems and detector instrumentation are also discussed.

NTIS

*Particle Accelerators; Electronics; Design Analysis*

**20070013962** Stanford Linear Accelerator Center, Stanford, CA, USA

### **Analysis of Shot Noise Propagation and Amplification in Harmonic Cascade FELs**

Huang, Z.; Sep. 01, 2006; 5 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-896422; SLAC-PUB-12097; No Copyright; Avail.: National Technical Information Service (NTIS)

The harmonic generation process in a harmonic cascade (HC) FEL is subject to noise degradation which is proportional to the square of the total harmonic order. In this paper, we study the shot noise evolution in the first-stage modulator and radiator of a HC FEL that produces the dominant noise contributions. We derive the effective input noise for a modulator operating in the low-gain regime, and analyze the radiator noise for a density-modulated beam. The significance of these noise sources in different harmonic cascade designs is also discussed.

NTIS

*Free Electron Lasers; Noise Propagation; Particle Accelerators; Shot Noise*

## 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*.

**20070014577** Lawrence Livermore National Lab., Livermore, CA USA, Missouri Univ., Rolla, MO, USA

### **Facilities for the Performance of Fano Effect Measurements as a Probe of Electron Correlation**

Tobin, J. G.; Yu, S. W.; Komesu, T.; Chung, B. W.; Morton, S. A.; Nov. 14, 2006; 7 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-48

Report No.(s): DE2006-896593; UCRL-PROC-226217; No Copyright; Avail.: National Technical Information Service (NTIS)

Fano Effect measurements are the key to direct observation of the Kondo or spin shielding intrinsic to models of electron correlation. The Fano Effect is the observation of spin polarized photoelectron emission from NONMAGNETIC materials, under chirally selective excitation, such as circularly polarized photons. Below are described three spectrometers, with which Fano Effects measurements have been made.

NTIS

*Electrons; Correlation; Photoelectrons; Polarization (Spin Alignment)*

**20070014730** Massachusetts Inst. of Tech., Cambridge, MA, USA, Fermi National Accelerator Lab., Batavia, IL, USA  
**Top Quark Properties from the Tevatron (FERMILAB-CONF-05-114-E)**

Klute, M.; May 2006; 5 pp.; In English

Report No.(s): DE2007-892334; FERMILAB-CONF-05-114-E; No Copyright; Avail.: National Technical Information Service (NTIS)

This report describes latest measurements and studies of top quark properties from the Tevatron in Run II with an integrated luminosity of up to 750 pb(sup -1). Due to its large mass of about 172 GeV/c(sup 2), the top quark provides a unique environment for tests of the Standard Model and is believed to yield sensitivity to new physics beyond the Standard Model. With data samples of close to 1 fb(sup -1) the CDF and D0 collaborations at the Tevatron enter a new area of precision top quark measurements.

NTIS

*Particle Accelerators; Quarks*

**20070014732** Fermi National Accelerator Lab., Batavia, IL, USA, Purdue Univ., West Lafayette, IN, USA  
**Searches for Supersymmetry at the Tevatron (FERMILAB-CONF-06-108-E)**

Lytken, E.; May 2006; 4 pp.; In English

Report No.(s): DE2007-892335; No Copyright; Avail.: National Technical Information Service (NTIS)

The results for searches for Supersymmetry at the Tevatron Collider are summarized in this paper. They focus here on searches for chargino/neutralino and the lightest stop, as well as scenarios with R-parity violation and split supersymmetry. No significant excesses with respect to the Standard Model were observed and constraints are set on the SUSY parameter space.

NTIS

*Quantum Chromodynamics; Supersymmetry*

**20070014734** Fermi National Accelerator Lab., Batavia, IL, USA, Siena Univ., Italy  
**Measurement of the Masses and Lifetimes of B Hadrons at the Tevatron**

Catastini, P.; May 2006; 4 pp.; In English

Report No.(s): DE2007-892339; FERMILAB-CONF-06-161-E; No Copyright; Avail.: National Technical Information Service (NTIS)

The latest results for the B Hadron sector at the Tevatron Collider are summarized. The properties of B hadrons can be precisely measured at the Tevatron. In particular they will focus on the masses and lifetimes. The new Tevatron results for the CP violation in B Hadrons are also discussed.

NTIS

*Hadrons; CP Violation; Particle Mass*

**20070014736** Fermi National Accelerator Lab., Batavia, IL, USA  
**Electroweak Measurements at the Tevatron (FERMILAB-CONF-06-260-E)**

Garcia, J. E.; Jun. 2006; 4 pp.; In English

Report No.(s): DE2007-892404; FERMILAB-CONF-06-260-E; No Copyright; Avail.: National Technical Information Service (NTIS)

Recent Electroweak measurements by the CDF and D0 collaborations in p(bar p) collisions (radical)s = 1.96 TeV are presented here. Measurements of W, Z and diboson production cross sections as well as W asymmetry using integrated luminosities up to 800 pb(sup -1) are reviewed. Limits on triple gauge anomalous couplings on diboson production are discussed elsewhere.

NTIS

*Electroweak Interactions (Field Theory); Electroweak Model; Bosons*

**20070014738** Fermi National Accelerator Lab., Batavia, IL, USA  
**Inclusive Jet Production at the Tevatron (FERMILAB-CONF-06-254E)**

Norniella, O.; Aug. 2006; 4 pp.; In English

Report No.(s): DE2007-892468; FERMILAB-CONF-06-245E; No Copyright; Avail.: National Technical Information Service (NTIS)

Preliminary results on inclusive jet production in proton-antiproton collisions at (radical)s = 1.96 TeV based on 1 fb(sup

-1) of CDF Run II data are presented. Measurements are performed using different jet algorithms in a wide range of jet transverse momentum and jet rapidity. The measured cross sections are compared to next-to-leading order perturbative QCD calculations.

NTIS

*Particle Accelerators; Proton-Antiproton Interactions; Quantum Chromodynamics*

**20070014739** Fermi National Accelerator Lab., Batavia, IL, USA, Nebraska Univ., Lincoln, NE, USA

**Inclusive Jet Cross Section Measurement at D0**

Voutilainen, M.; Sep. 2006; 4 pp.; In English

Report No.(s): DE2007-892476; FERMILAB-CONF-06-342-E; No Copyright; Avail.: National Technical Information Service (NTIS)

We present a new preliminary measurement of the inclusive jet cross section in  $p(\bar{p})$  collisions based on a integrated luminosity of about 0.8 fb(sup -1). The data were acquired using the D0 detector between 2002 and 2005. Jets are reconstructed using an iterative cone algorithm with radius  $R(\text{sub cone}) = 0.7$ . The inclusive jet cross section is presented as a function of transverse jet momentum and rapidity. Predictions from perturbative QCD in next-to-leading order, plus threshold corrections in 2-loop accuracy describe the shape in the transverse jet momentum.

NTIS

*Proton-Antiproton Interactions; Quantum Chromodynamics*

**82**

**DOCUMENTATION AND INFORMATION SCIENCE**

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

**20070013762** Naval War Coll., Newport, RI USA

**Operational Implications of Public Affairs - Factors, Functions, and Challenges of the Information Battlefield**

Crotts, Derik W; May 17, 2005; 26 pp.; In English

Report No.(s): AD-A463400; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463400>

In today's operational environment the impact and influence of the public is becoming more relevant. With the ability to monitor daily operational decisions and actions, the public response can change the direction or outcome of a battle. This shift in influence has been a direct result of the advances in information technology during the past decade. These advances have reduced operational space, decreased the decision cycle, and added information collection and dissemination capabilities to the individual service member. The result is more information available to the public and an increased importance of public affairs management. The operational impacts of new media and command information concepts and capabilities have placed commanders in a reactive operational posture, struggling to counter perceptions and maintain public support, based on the fragmented operational snapshot provided by the media. In essence, today's informational environment has transformed public affairs into an operational function that commanders have failed to effectively synchronize. Unless operational commanders fully incorporate all public affairs capabilities into their operations, develop procedures to harness the information technology within their commands and establish habitual relationships with the media, they will not possess the ability to maintain the public will and operational tempo necessary to sustain and win on today's battlefield.

DTIC

*Military Operations; Public Relations*

**20070013823** Pietragallo, Bosic and Gordon, Pittsburgh, PA, USA

**Diffraction Grating**

Challener, W. A.; Gage, E. C.; Rausch, T.; Mihalcea, C.; Mountfield, K.; 10 Jan 05; 14 pp.; In English

Contract(s)/Grant(s): NIH-70NANB1H3056

Patent Info.: Filed Filed 10 Jan 05; US-Patent-Appl-SN-11-032 277

Report No.(s): PB2007-103094; No Copyright; Avail.: CASI: A03, Hardcopy

Diffraction gratings for coupling an electromagnetic wave into a planar waveguide are disclosed. The diffraction grating may include a first diffraction grating and a second diffraction grating slanted relative to one another. Alternatively, the

diffraction grating may include a first diffraction grating and a second diffraction grating spaced apart to form a gap therebetween.

NTIS

*Electromagnetic Radiation; Gratings (Spectra); Waveguides*

**20070013945** Saint Louis Univ., MO, USA

**From Best Practices to Quality Patient Care - Business Models for Health Information Technologies**

Balas, E. A.; Krishna, S.; DeLeo, G.; Nov. 2003; 11 pp.; In English

Contract(s)/Grant(s): 7R13HS012087-02

Report No.(s): PB2007-107231; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The goal of the conference is to examine the process of cost-effective health information technology transfer and advance the business case for innovation that improves outcomes and protects patient safety.

NTIS

*Commerce; Health; Patients; Procedures*

**20070014768** Environmental Protection Agency, Washington, DC, USA

**Pollution Prevention Information Exchange System (PIES) User Guide Version 2.1**

Nov. 1992; 134 pp.; In English

Report No.(s): PB2007-107068; EPA/600/R-92/213; No Copyright; Avail.: CASI: [A07](#), Hardcopy

A major component of the clearinghouse is the computerized information exchange system, known as the PIES. This system provides a public forum for exchange of questions and information relating to pollution prevention. This manual explains how to log on, register, and access the news and information data bases of the PIES. The PIES is an information resource and communication network that allows those who wish to establish pollution prevention programs, implement industrial options, or develop research and development projects, to benefit from the experience, progress, and knowledge of their peers. The PIES has been expanded into an international forum on pollution prevention for all levels of government, researchers, industry, and public interest groups.

NTIS

*Information Dissemination; Information Systems; Pollution Control*

**20070014775** Food and Drug Administration, Rockville, MD, USA

**Guidance: Drug Safety Information. FDA's Rock Communication to the Public**

Mar. 2007; 17 pp.; In English

Report No.(s): PB2007-107149; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This document provides guidance on how FDA is developing and disseminating information to the public regarding important drug safety issues, including emerging drug safety information. As discussed in more detail below, an important drug safety issue is one that has the potential to alter the benefit/risk analysis for a drug in such a way as to affect decisions about prescribing or taking the drug. The term emerging drug safety information refers to information about an important drug safety issue that has not yet been fully analyzed or confirmed.

NTIS

*Drugs; Information Dissemination; Safety; Food*

**20070014786** CH2M/Hill Hanford Group, Inc., Richland, WA, USA

**Legacy Management Requires Information**

Connell, C. W.; Hildebrand, R. D.; Feb. 2007; 13 pp.; In English

Report No.(s): DE2006-896714; HNF-31070-FP; No Copyright; Avail.: Department of Energy Information Bridge

Legacy Management Requires Information describes the goal(s) of the US Department of Energy's Office of Legacy Management (LM) relative to maintaining critical records and the way those goals are being addressed at Hanford. The paper discusses the current practices for document control, as well as the use of modern databases for both storing and accessing the data to support cleanup decisions. In addition to the information goals of LM, the Hanford Federal Facility Agreement and Consent Order, known as the 'Tri-Party Agreement' (TPA) is one of the main drivers in documentation and data management. The TPA, which specifies discrete milestones for cleaning up the Hanford Site, is a legally binding agreement among the US Department of Energy (DOE), the Washington State Department of Ecology (Ecology), and the US Environmental Protection Agency (EPA). The TPA requires that DOE provide the lead regulatory agency with the results of analytical laboratory and



non-laboratory tests/readings to help guide them in making decisions. The Agreement also calls for each signatory to preserve--for at least ten years after the Agreement has ended--all of the records in its or its contractors, possession related to sampling, analysis, investigations, and monitoring conducted. The tools used at Hanford to meet TPA requirements are also the tools that can satisfy the needs of LM.

NTIS

*Radioactive Wastes; Waste Management; Environment Protection; Management Information Systems; Data Management*

## 85

### TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety*, *16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

**20070013851** Texas Univ., El Paso, TX, USA

#### **Tack Coat Field Acceptance Criterion**

Eedula, S. R.; Tandon, V.; May 2006; 73 pp.; In English

Report No.(s): PB2007-107256; RR-TX-0-5216-1; No Copyright; Avail.: CASI: [A04](#), Hardcopy

Recently, TxDOT has experienced an increase in the number of pavement failures that may be attributed to the poor quality of tack coat applied. To identify quality of tack coat before overlay is placed on top of it, a device UTEP Pull-off Device (UPOD) that measures quality of tack coat has been developed. The device can be placed on top of the tack coat layer after specified interval and quality of tack coat is evaluated based on the magnitude of cohesive strength. The developed device is simple, reliable, economical, and could determine the quality of the tack coat in less than 45 minutes after application of tack coat. Although UPOD can measure the quality of tack coat, a field acceptance criterion has not been established and is the objective of this research. To develop the criterion, the laboratory and field tests were performed with the help of TxDOT. Based on the laboratory and field test results, an acceptance criterion has been proposed.

NTIS

*Pavements; Transportation; Highways; Roads; Coatings; Asphalt*

## 88

### SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 193*.

**20070013892** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **The Microgravity Science Glovebox (MSG), a Resource for Gravity-Dependent Phenomena Research on the International Space Station (ISS)**

Spivey, Reggie A.; Jeter, Linda B.; Vonk, Chris; Jan. 11, 2007; 51 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA

Contract(s)/Grant(s): NAS8-02060; Copyright; Avail.: CASI: [A04](#), Hardcopy

The Microgravity Science Glovebox (MSG) is a double rack facility aboard the International Space Station (ISS) designed for gravity-dependent phenomena investigation handling. The MSG has been operating in the ISS US Laboratory Module since July 2002. The MSG facility provides an enclosed working area for investigation manipulation and observation in the ISS. The MSG's unique design provides two levels of containment to protect the ISS crew from hazardous operations. Research investigations operating inside the MSG are provided a large 255 liter work volume, 1000 watts of dc power via a versatile supply interface (120,28, +/-12, and 5 Vdc), 1000 watts of cooling capability, video and data recording and real time downlink, ground commanding capabilities, access to ISS Vacuum Exhaust and Vacuum Resource Systems, and gaseous nitrogen supply. With these capabilities, the MSG is an ideal platform for research required to advance the technology readiness levels (TRL) needed for the Crew Exploration Vehicle and the Exploration Initiative. Areas of research that will benefit from investigations in the MSG include thermal management, fluid physics, spacecraft fire safety, materials science, combustion and reacting control systems, in situ fabrication and repair, and advanced life support technologies. This paper will provide a detailed explanation of the MSG facility, a synopsis of the research that has already been accomplished in the MSG,

an overview of investigations planning to operate in the MSG, and possible augmentations that can be added to the MSG facility to further enhance the resources provided to investigations.

Author

*International Space Station; Gravitational Effects; Life Support Systems; Microgravity; Exhaust Systems; Vacuum Systems; Video Data; Aerospace Safety*

**20070014486** NASA Johnson Space Center, Houston, TX, USA

**International Space Station Research Summary Through Expedition 10**

Robinson, Julie A.; Rhatigan, Jennifer L.; Baumann, David K.; Tate, Judy; Thumm, Tracy; September 2006; 142 pp.; In English; See also 20070014487 - 20070014557; Original contains color illustrations

Report No.(s): NASA/TP-2006-213146; S-978; Copyright; Avail.: CASI: [A07](#), Hardcopy

This report summarizes research accomplishments on the International Space Station (ISS) through the first ten Expeditions. When research programs for early Expeditions were established, five administrative organizations were executing research on ISS: bioastronautics research, fundamental space biology, physical science, space product development, and space flight. The Vision for Space Exploration led to changes in NASA's administrative structures, so we have grouped experiments topically by scientific themes human research for exploration, physical and biological sciences, technology development, observing the Earth, and educating and inspiring the next generation even when these do not correspond to the administrative structure at the time at which they were completed. The research organizations at the time at which the experiments flew are preserved in the appendix of this document. These early investigations on ISS have laid the groundwork for research planning for Expeditions to come. Humans performing scientific investigations on ISS serve as a model for the goals of future Exploration missions. The success of a wide variety of investigations is an important hallmark of early research on ISS. Of the investigations summarized here, some are completed with results released, some are completed with preliminary results, and some remain ongoing

Author

*International Space Station; Research Facilities; Bioastronautics; Biotechnology; Exobiology; Expeditions*

**20070014489** Harvard Univ., Cambridge, MA, USA

**Binary Colloidal Alloy Test-3 (BCAT-3)**

Weitz, David A.; Pusey, Peter; Schofield, Andrew; Yodh, Arjun; Zhang, Jian; International Space Station Research Summary Through Expedition 10; September 2006, pp. 37-38; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Binary Colloidal Alloy Test-3 (BCAT-3) hardware supported three investigations in which ISS crews photographed samples of colloidal particles (tiny nanoscale spheres suspended in liquid) to document liquid/gas phase changes, growth of binary crystals, and the formation of colloidal crystals confined to a surface. Colloids are small enough that in a microgravity environment without sedimentation and convection, they behave much as atoms and so can be used to model all sorts of phenomena because their size, shape, and interactions can be controlled. The BCAT-3 payload consists of ten small samples of colloid alloys in which the microscopic colloid particles are mixed together into a liquid. These ten samples are contained within a small case that is the size of a school textbook. At the start of an experiment run, all ten samples are shaken to completely remix the colloid samples, much in the same way that salad dressing must be shaken to remix oil and vinegar. After the samples are mixed, what remains is periodically photographed using a digital camera until the colloid and liquid components of those samples have separated or the polymers have formed crystals. The samples can be remixed to repeat the experiment. The ten samples in BCAT-3 were selected as part of three separate experiments examining different physical processes: critical point, binary alloys, and surface crystallization.

Author

*Binary Alloys; Colloids; Liquid Phases; Microparticles; Sediments; Crystallization; Convection; Microgravity*

**20070014490** NASA Langley Research Center, Hampton, VA, USA

**Materials International Space Station Experiment-1 and -2 (MISSE-1 and -2)**

Kinard, William H.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 89; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Researchers from the private and public sector prepared a wide range of samples for the first externally mounted experiment on ISS. Materials International Space Station Experiment (MISSE)-1 and -2 are testbeds for more than 400 materials and coatings samples, testing their survivability under the corrosive effects of the space environment; including

micrometeoroid and orbital debris strikes, atomic oxygen attack, intense ultraviolet radiation from the sun, and extreme temperature swings. Results will provide a better understanding of the durability of various materials in this environment. Many of the materials may have applications in the design of future spacecraft. Both MISSE-1 and -2 were deployed in August 2001 on Expedition 3 and were planned for a one-year exposure. Due to the delays incurred following the Columbia accident, they were not retrieved until four years later during ISS Expedition 11 in August 2005. Follow-on samples are now on board station (MISSE-5) or are planned for the future (MISSE-3, MISSE-4, and MISSE-6).

Author

*Aerospace Environments; International Space Station; Deployment; Micrometeoroids; Space Debris; Corrosion*

**20070014491** NASA Johnson Space Center, Houston, TX, USA

**Expedition 8 (Oct 20, 2003 - Apr 29, 2004)**

Foale, C. Michael; International Space Station Research Summary Through Expedition 10; September 2006, pp. 123; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

As compared to the scientific workload borne by Expedition 7 as the crewmembers accustomed themselves to working with a reduced number, the Expedition 8 crew carried a heavier workload in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB).

Author

*Bioastronautics; Exobiology; Workloads (Psychophysiology); Product Development*

**20070014492** NASA Johnson Space Center, Houston, TX, USA

**Expedition 9 (Apr 21, 2004 - Oct 23, 2004)**

Fincke, Edward Michael; International Space Station Research Summary Through Expedition 10; September 2006, pp. 124; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

For the Expedition 9 crew of Gennady Pedalka and Mike Fincke, scientific research was a ruling passion. Accordingly and in keeping with the pattern established by earlier Expeditions, they conducted experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB)

Author

*Bioastronautics; Exobiology; Product Development*

**20070014493** NASA Johnson Space Center, Houston, TX, USA

**Expedition 10 (Oct 15, 2004 - Apr 25, 2005)**

Chiao, Leroy; International Space Station Research Summary Through Expedition 10; September 2006, pp. 125; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

For the Expedition 10 crew of Salizan Sharipov and Leroy Chiao, the focus was on 'knowing how' to work for long durations in space and to continue to develop methods and technologies that would aid the space program in a future return to the moon and exploration of Mars. Accordingly and in keeping with the pattern established by earlier Expeditions, they conducted experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB)

Author

*Bioastronautics; Exobiology; Product Development*

**20070014494** NASA Kennedy Space Center, Cocoa Beach, FL, USA

**Space Exposed Experiment Developed for Students (EDUCATION-SEEDS)**

Levine, Howard; International Space Station Research Summary Through Expedition 10; September 2006, pp. 105; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

During the Education-Space Exposed Experiment Development for Students (SEEDS) experiment, eight pouches of soybean and corn seeds flew on station and germinated under either dark or lighted conditions. A grid along the side of the pouch allowed the crew to determine the amount of growth without opening the pouches. In addition, microgravity-exposed seeds were distributed to schools in Fall 2001 and students conducted germination experiments comparing them with seeds that had not flown in space.

Author

*Spaceborne Experiments; Microgravity; Soybeans; Education; Students*

**20070014495** NASA Ames Research Center, Moffett Field, CA, USA

**Plant Generic Bioprocessing Apparatus (PGBA)**

Heyenga, Gerard; International Space Station Research Summary Through Expedition 10; September 2006, pp. 81; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Plant Generic Bioprocessing Apparatus (PGBA) is used to grow and monitor plants in microgravity experiments. PGBA is a self-contained plant growth chamber that provides preset or remotely controlled temperature, humidity, nutrient delivery, and light. The PGBA venting system also supplies the plants with ambient air and controls ethylene buildup. The objective during Expedition 5 was to grow two crops of *Arabidopsis thaliana* (thale cress). The first crop was to be harvested when it reached maturity and placed into cold storage. The second crop was to be started at the harvest of the first crop and returned to Earth while it was still growing. Scientific objectives were focused on understanding lignin production. The returned plant material did not develop in a normal manner, and the primary scientific objectives were not met. The study did, however, help to identify the need for greater regulation of air quality within a PGC to ensure uniform plant growth. Although no results will be published from this ISS activity, lessons learned from this study are being applied to the development of subsequent plant growth investigations and improved space flight plant chamber design (Heyenga et al. 2005).

Author

*Bioprocessing; Microgravity; Plants (Botany); Phytotrons; Plant Growth Regulators*

**20070014496** Portland State Univ., OR, USA

**Capillary Flow Experiment-Contact Line (CFE-CL)**

Weislogel, Mark M.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 85-86; In English; See also 20070014486; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Capillary Flow Experiments (CFEs) are a suite of fluid physics experiments whose purpose is to investigate capillary flows and phenomena in low gravity. The CFE data to be obtained will be crucial to future space exploration because they provide a foundation for physical models of fluids management in microgravity, including fuel tanks and cryogen storage systems, TCSs (e.g., water recycling), and materials processing in the liquid state. NASA's current plans for Exploration missions assume the use of larger liquid propellant masses than have ever flown before. Under low-gravity conditions, capillary forces can be exploited to control fluid orientation so that such large mission-critical systems perform predictably. The handheld experiments common to the suite aim to provide results of critical interest to the capillary flow community that cannot be achieved in ground-based tests; for example, dynamic effects associated with a moving contact boundary condition, capillary driven flow in interior corner networks, and critical wetting phenomena in complex geometries. Specific applications of the results center on particular fluids challenges concerning propellant tanks. The knowledge gained will help spacecraft fluid systems designers increase system reliability, decrease system mass, and reduce overall system complexity.

Author

*Fluid Dynamics; Capillary Flow; Microgravity; Propellant Tanks; Liquid Rocket Propellants; Cryogenics; Boundary Conditions*

**20070014497** NASA Glenn Research Center, Cleveland, OH, USA

**Dust and Aerosol Measurement Feasibility Test (DAFT)**

Urban, David; International Space Station Research Summary Through Expedition 10; September 2006, pp. 87; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Our understanding of how fires burn in a spacecraft has evolved since the fire detection equipment on space shuttle and space station was developed. One thing we have learned is that smoke particles that form in microgravity can be larger than those formed on Earth. Since smoke detectors are gauged to detect certain sizes of particles, this knowledge could help design more accurate smoke detectors for future spacecraft. The Smoke and Aerosol Measurement Experiment (SAME) is planned to gather particulate size information on ISS. The DAFT experiment, which was initiated after the Columbia accident, is to be used to obtain data in preparation for SAME using very little upmass. DAFT is intended to assess and characterize the distribution of particles in the air inside ISS to allow assessment of the suitability of current shuttle and ISS smoke detectors. This experiment was begun on Expedition 10 and is planned for completion during Expedition 13. DAFT is designed to test the effectiveness of the P-Trak Ultrafine Particle Counter, a device that counts ultra-fine dust particles in a microgravity environment. Most particle counters work by using a laser to record instances when the beam is interrupted; however, this method will not record ultra-fine particles that are much smaller than the wavelength of the light. P-Trak works by passing dust-laden air through a chamber of vaporous isopropyl alcohol. When a droplet of alcohol condenses over an ultra-fine dust particle, the particle becomes large enough to break the light beam and be counted. The alcohol is then recycled as it condenses

on sidewalls and gravity pulls the alcohol back to the saturator. If the results are satisfactory, P-Trak will be used in SAME, which requires counts of particles ranging from 0.2-1 micron.

Author

*Dust; Aerosols; Smoke Detectors; Particulates; Feasibility; Fires; Microgravity*

**20070014498** NASA Johnson Space Center, Houston, TX, USA

**Expedition 5 (Jun 7, 2002 - Dec 2, 2002)**

International Space Station Research Summary Through Expedition 10; September 2006, pp. 120; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

As ISS continued to grow and expand, so too did the scientific workload for the Expedition crews especially, and critically, augmented by the installation of the MSG. The Expedition 5 crew arrived on station faced with the largest workload to date of both continuing and new experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB): A Study of Radiation Doses Experienced by Astronauts in EVA (BR), Crewmember and Crew-Ground Interactions During International Space Station Missions (BR), Effect of Microgravity on the Peripheral Subcutaneous Veno-arteriolar Reflex in Humans (BR), Effect of Prolonged Space Flight on Human Skeletal Muscle (BR), Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function (BR), Promoting Sensorimotor Response Generalizability (BR), Renal Stone Risk During Space Flight: Assessment and Countermeasure Evaluation (BR), Space Flight-induced Reactivation of Latent Epstein-Barr Virus (BR), Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (BR), Test of Midodrine as a Countermeasure Against Postflight Orthostatic Hypotension (BR), Microencapsulation Electrostatic Processing System (PS), Protein Crystal Growth-Single Locker Thermal Enclosure System (PS), Solidification Using a Baffle in Sealed Ampoules (PS), StelSys Liver Cell Function Research (PS), Toward Understanding Pore Formation and Mobility During Controlled Directional Solidification in a Microgravity Environment (PS), Active Rack Isolation System-ISS Characterization Experiment (SPD), Advanced Astroculture-TM (SPD), Materials International Space Station Experiment (SPD), Microgravity Acceleration Measurement System (SPD), Plant Generic Bioprocessing Apparatus (SPD), Space Acceleration Measurement System-II (SPD), Crew Earth Observations (SF), Earth Knowledge Acquired by Middle School Students (FSB), and Education Payload Operations (FSB).

Author

*Bioastronautics; Expeditions; International Space Station; Space Flight; Spaceborne Experiments; Physical Sciences; Exobiology*

**20070014499** NASA Johnson Space Center, Houston, TX, USA

**Expedition 6 (Nov 25, 2002 - May 3, 2003)**

Pettit, Donald R.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 121; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

As station entered its third year of continuous operations, the scientific workload continued to occupy a significant amount of the Expedition crews time. The Expedition 6 crew worked unremittingly on the scientific mission in face of the changes wrought following the loss of Columbia, conducting experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB): A Study of Radiation Doses Experienced by Astronauts in EVA (BR), Chromosomal Aberrations in Blood Lymphocytes of Astronauts (BR), Effect of Prolonged Space Flight on Human Skeletal Muscle (BR), Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function (BR), Foot/Ground Reaction Forces During Space Flight (BR), Promoting Sensorimotor Response Generalizability (BR), Renal Stone Risk During Space Flight (BR), Space Flight-induced Reactivation of Latent Epstein-Barr Virus (BR), Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (BR), Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions (PS), Protein Crystal Growth-Single Locker Thermal Enclosure System (PS), Zeolite Crystal Growth (PS), Materials International Space Station Experiment (SPD), Microgravity Acceleration Measurement System (SPD), Space Acceleration Measurement System-II (SPD), Crew Earth Observations (SF), and Earth Knowledge Acquired by Middle-School Students (FSB).

Author

*Expeditions; International Space Station; Spaceborne Experiments; Bioastronautics; Physical Sciences; Space Flight; Exobiology*



**20070014502** Boeing Co., Seattle, WA, USA

**Active Rack Isolation System-ISS Characterization Experiment (ARIS-ICE)**

Bushnell, Glenn; Fialho, Ian J.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 94-95; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Constant microgravity conditions are essential for some ISS experiments. Sources of disturbance can include minor changes in acceleration, the movement of hardware such as the space station remote manipulator system (the robotic arm), or even normal crew activities, any of which can cause subtle vibrations to be transferred through station. The active rack isolation system (ARIS) protects equipment by absorbing the shock of motion before it can affect an experiment. ARIS is installed in two EXPRESS racks on ISS (EXPRESS Rack 2 and EXPRESS Rack 3), where it reduces vibrations using a combination of sensors and actuators. When the sensors detect a disturbance, the actuators counter the effect by sending a reactive force between the EXPRESS rack and the laboratory module, much as a shock absorber on an automobile would, except this 'smart' shock absorber is finely tuned to react to, and cancel out, very minute vibrations. Accelerometer assemblies measure the disturbances and send data to the ARIS electronic control unit. The electronic control unit signals pushrods to press against the framework of station, stabilizing the rack. A microgravity rack barrier prevents accidental disturbances to the active ARIS rack. ARIS is designed to isolate all frequencies greater than 0.01 Hz, and is most effective in the 0.05- to 300-Hz range. The ARIS-ISS Characterization Experiment (ICE) was a payload activity to characterize the ARIS on-orbit performance by monitoring the ambient vibration environment and by generating disturbances. The shaker unit provided a precise, measurable disturbance that simulated possible station vibrations. The other major component of ICE is the payload on-orbit processor, which executed characterization tests and acquired, synchronized, and processed ICE and SAMS-II data for downlink.

Author

*Shock Absorbers; Vibration; Control Equipment; Actuators; Stabilization; Reactivity; Microgravity*

**20070014504** Microgen, LLC, Galveston, TX, USA

**Space Flight-induced Reactivation of Latent Epstein-Barr Virus (EPSTEIN-BARR)**

Stowe, Raymond; International Space Station Research Summary Through Expedition 10; September 2006, pp. 20; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

In the USA, approximately 95% of adults have been infected with Epstein-Barr Virus (EBV), one of the most common of human viruses and a member of the herpes virus family. EBV is an initial infection that establishes a lifelong dormant infection inside the body that can be reactivated by illness or stress. Once active, EBV causes infectious mononucleosis, cancers, and other disorders associated with the lymphatic system in people with a compromised immune system. Decreased cellular immune function, likely caused by a combination of the microgravity environment and the stresses associated with a mission, is experienced by astronauts in space flight. With longer-duration missions, it is hypothesized that latent viruses are more likely to be reactivated, placing the crew at risk of developing and spreading infectious illnesses and jeopardizing the mission. Preliminary studies of astronauts have shown increased EBV shedding (the means by which viruses reproduce) in the saliva and increased antibody titers to the virus's proteins. This study is examining the levels to which the crew's immune systems are suppressed during space flight and identifying conditions under which the virus will reactivate. To conduct Epstein-Barr, investigators collect urine and blood samples preflight and again postflight. The samples are analyzed for stress hormones and cytokines (messengers of the immune system), EBV replication, and virus-specific T-cell immune function. Epstein-Barr will determine the levels to which the crew's immune systems are suppressed during space flight and identify conditions under which EBV will reactivate. The investigators will analyze stress hormones and cytokines, which are the messengers of the immune system. They will also analyze EBV replication and determine virus-specific T-cell immune function.

Author

*Infectious Diseases; Viruses; Immune Systems; Lymphatic System; Microgravity; Cytology*

**20070014505** University of Southern Mississippi, Hattiesburg, MS, USA

**Miscible Fluids in Microgravity (MFMG)**

Pojman, John; International Space Station Research Summary Through Expedition 10; September 2006, pp. 45; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The goal of the Miscible Fluids in Microgravity (MFMG) experiment is to test the fluid dynamics between two miscible (or mixable) liquids in a microgravity environment provided by ISS. The interaction between two miscible liquids here on Earth would be masked by the effects of either gravity or density, and, in effect, the two miscible liquids would combine into

one relatively homogenous (or equally distributed) solution. In microgravity, miscible liquids may behave completely differently, potentially taking on properties more akin to immiscible (or non-mixable) liquids, and supporting a theory proposed by Korteweg over 100 years ago. Testing Korteweg's hypothesis is challenging on Earth because the force of gravity overwhelms surface tension, but the microgravity environment on station provides an ideal opportunity to do so. This experiment originated from a call for simple experiments requiring little upmass following the grounding of the space shuttle fleet after the loss of Columbia. The MFMG experiment was proposed as a simple study of miscible fluids limited to the use of ordinary items already on board ISS (unused syringes, water, honey, Ziploc bags, a still camera, and a video camera). In the isothermal experiment (where diffusive forces predominate in microgravity), a stream of either honey or water was introduced into a syringe of the opposite fluid to observe the transient behavior of the miscible fluids. In the thermal experiment, a temperature gradient was created across the syringe holding one of the fluids, and a second fluid was introduced at ambient temperature. Korteweg's theory predicts that miscible fluids will demonstrate interfacial tension transiently until diffusion prevails. Under normal gravity, the stream of honey would break apart under its own weight and surface tension would cause the fluid to have as little surface area as possible for a given volume. The droplets that form as the stream breaks apart would have less surface area than a cylinder (stream) of the same volume, an effect known as Rayleigh instability. The experiment will determine whether the stream exhibits the Rayleigh instability characteristic of immiscible fluids.

Author

*Microgravity; Fluid Dynamics; Drops (Liquids); Interfacial Tension; Solubility; Gravitational Effects; Diffusivity*

**20070014506** NASA Johnson Space Center, Houston, TX, USA

**Exploration Lessons Learned from the Operation of ISS**

International Space Station Research Summary Through Expedition 10; September 2006, pp. 112; In English; See also 20070014486; Copyright; Avail.: CASI: [A01](#), Hardcopy

Constructing and operating ISS serves as a testbed for new technologies and techniques in support of the crew exploration vehicle (CEV) and lunar mission hardware design and development. Lessons learned from the operation of life support technologies on station are directly applicable to the selection and operation of systems for future Exploration vehicles. The limited resupply following the Columbia accident served as a model for operation of future Exploration missions to the moon and Mars. Lessons learned from ISS are directly applicable to the design, development, operations, and management of future Exploration missions.

Author

*International Space Station; Space Exploration; Space Missions; Technology Utilization*

**20070014507** NASA Johnson Space Center, Houston, TX, USA

**Expedition 2 (Mar 10, 2001 - Aug 20, 2001)**

Voss, James S.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 117; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

As ISS continued to grow and expand with the installation of new experiment facilities and hardware on the U.S. Destiny laboratory, the capacity for research on board station increased accordingly. From the original four experiments conducted on Expedition 1, Expedition 2 expanded the research potential vastly to include experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), and space flight (SF): Bonner Bell Neutron Detector (BR), Crewmember and Crew-Ground Interaction During International Space Station Missions (BR), Dosimetric Mapping (BR), Effects of Altered Gravity on Spinal Cord Excitability (BR), Organ Dose Measurement Using the Phantom Torso (BR), Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (BR), Commercial Protein Crystal Growth-High-Density (PS), Experiment Physics of Colloids in Space (PS), Protein Crystal Growth-Enhanced Gaseous Nitrogen (PS), Protein Crystal Growth-Single Locker Thermal Enclosure System (PS), Active Rack Isolation System-ISS Characterization Experiment (SPD), Advanced Astroculture-TM (SPD), Microgravity Acceleration Measurement System (SPD), Middeck Active Control Experiment-II (SPD), Space Acceleration Measurement System II (SPD), Crew Earth Observations (SF), and Earth Knowledge Acquired by Middle-School Students (SF).

Author

*Expeditions; International Space Station; Spaceborne Experiments; Research Facilities; Space Flight*

**20070014508** NASA Johnson Space Center, Houston, TX, USA

**Expedition 1 (Nov 2, 2000 - Mar 18, 2001)**

Shepherd, Bill; International Space Station Research Summary Through Expedition 10; September 2006, pp. 116; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

When the three-man Expedition 1 crew moved into ISS, they began not only a habitation that continues to this day but also became part of a station that was a work-in-progress. The Zvezda service module provided their early living quarters. At this time the ISS also consisted of the Zarya module (the Functional Cargo Block), Node 1 (the Unity module), and a Soyuz spacecraft (in which the crew had arrived and which supplied their assured crew return capability). Later in Expedition 1, the U.S. Destiny laboratory was installed. Yet despite the Spartan living conditions and the sense of working on a platform under construction, the crew made significant advances in four experiments into physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB): Protein Crystal Growth-Enhanced Gaseous Nitrogen Ewer (PS), Middeck Active Control Experiment-II (SPD), Crew Earth Observations (SF), and Space Exposed Experiment Developed for Students (FSB). While some of these experiments are unique to only one or two Expeditions (Education-SEEDS, for example), others continued to be run and CEO is running yet through several Expeditions.

Derived from text

*Expeditions; International Space Station; Spaceborne Experiments; Exobiology; Physical Sciences; Space Flight; Space Processing*

**20070014509** Harvard Univ., Cambridge, MA, USA

**EXPRESS Physics of Colloids in Space (EXPPCS)**

Weitz, David A.; Pusey, Peter N.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 40-41; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Colloids can be defined as fluids with other particles dispersed in them, particularly particles of size between 1 nanometer and 1 micrometer. Since colloids have widespread uses in nature and industry, understanding of the underlying physics that controls their behavior is important. Under the proper conditions, colloidal particles can self-assemble to form ordered arrays, or crystals. On Earth, the ordering of these particles is mostly directed by gravitational effects, sedimentation, and buoyancy. Self-assembly does not occur. Thus, the weightlessness of low Earth orbit is an important element in the study of colloids. Physics of Colloids in Space (PCS) focused on the growth, dynamics, and basic physical properties of four classes of colloids: binary colloidal crystals, colloid-polymer mixtures, fractal gels, and glass. These were studied using static light scattering (for size or positions of the colloids or structures formed), dynamic light scattering (to measure motions of particles or structures), rheological (flow) measurement, and still imaging.

Author

*Colloids; Weightlessness; Gravitational Effects; Flow Measurement; Gels; Fractals; Rheology; Crystals*

**20070014510** Dynamac Corp., Cocoa Beach, FL, USA

**Photosynthesis Experiment and System Testing and Operation (PESTO)**

Stutte, Gary; International Space Station Research Summary Through Expedition 10; September 2006, pp. 79-80; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The PESTO investigation, conducted in concert with technology verification for the BPS hardware, measured the canopy photosynthesis (the production of oxygen and carbohydrates from CO<sub>2</sub> and water in the environment) of *Triticum aestivum* (super dwarf wheat). The wheat was grown under high light and controlled CO<sub>2</sub> conditions in microgravity. The investigation also measured the metabolic effects on the photosynthetic apparatus to quantify the effects on metabolism and to model the impact of microgravity on biological approaches to atmospheric regeneration. To test the hypothesis that the carbon exchange rates would be the same in microgravity as on Earth, investigators measured and characterized the CO<sub>2</sub> and light response curves for a wheat photosynthetic canopy grown in microgravity. Data came from various sources: gas samples taken from the closed atmosphere inside the chambers; liquid samples taken through ports in the chambers; plant tissue samples extracted by the crew during different points in the growth cycle; and, finally, plant tissue extracted from the live plants returned to Earth inside the BPS. The investigators analyzed the plant tissue postflight for primary photosynthesis parameters, such as electron transport, carbohydrate partitioning, and photosystem (the biochemical pathway for photosynthesis). Measurements were taken over a range of relative humidity conditions to discover whether atmospheric vapor pressure deficits affect gas exchange in microgravity.

Author

*Photosynthesis; Carbon Dioxide; Carbohydrates; Oxygen; Wheat; Microgravity; Atmospheric Pressure; Vapor Pressure*

**20070014511** California Inst. of Tech., Pasadena, CA, USA

**Viscous Liquid Foam-Bulk Metallic Glass (FOAM)**

Johnson, William; Veazey, Chris; International Space Station Research Summary Through Expedition 10; September 2006, pp. 43; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Bulk metallic glasses are a special class of metallic materials created by rapid solidification that causes them to form glass-like structures that are light but very strong. This experiment investigates the formation and structure of foams made from bulk metallic glass. Because the effects of buoyancy are minimized in space, more uniform foam structures with unique properties can be produced. These new materials have potential applications for use in future moon or Mars space structures (due to their high strength and low weight) as well as for potential shielding against micrometeorites and space debris impacts on spacecraft. Three planned runs for the Foam experiment were successfully completed on station during Expedition 9. Samples, which were returned to Earth in late August 2005, are being analyzed.

Author

*Foams; Metallic Glasses; Liquids; Viscous Flow; Spaceborne Experiments*

**20070014512** Dreamtime Holdings, Inc., Moffett Field, CA, USA

**DreamTime (DREAMTIME)**

Mason, Ben; International Space Station Research Summary Through Expedition 10; September 2006, pp. 108; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

As part of the DreamTime project a commercial high-definition television (HDTV) system was flown on ISS. The camera's COTS battery system and a dedicated cable were modified to allow the batteries to interface with station on-board EVA tool charger. When compared to standard television video, high-definition video appears four times sharper, giving a considerably more detailed image. The audio is also improved with HDTV, which records on 5.1 channels vs. the standard two channels in typical stereo systems, in effect providing surround-sound capability. Dreamtime was used on ISS to provide these enhanced images and audio for ground-based observers. In developing the original public-private partnership, NASA had hoped that DreamTime would play a role in developing commercial products based on the historic activities on ISS. Lacking commercial direction from DreamTime, yet recognizing the historical significance of activities on the station, NASA took the initiative and developed scenarios and created storyboards for the flight crew to record ISS documentary footage of outstanding quality during the mission. The result of this effort returned over 500 minutes of HDTV footage, suitable for commercial purposes, and far exceeding the expected imagery return. The private company that originally sponsored DreamTime was short-lived, and no results were generated. The Bioastronautics Research Program has created the video Secrets of Science in Outer Space using some of the DreamTime footage.

Author

*High Definition Television; International Space Station; Video Equipment; Onboard Equipment*

**20070014514** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Toward Understanding Pore Formation and Mobility During Controlled Directional Solidification in a Microgravity Environment (PFMI)**

Grugel, Richard; International Space Station Research Summary Through Expedition 10; September 2006, pp. 46-47; In English; See also 20070014486; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

On Earth, bubbles that form in molten materials rise to the surface and release trapped gas prior to solidification. In microgravity, where there is no buoyancy or convection, bubbles can become trapped inside the material, leaving pores as the material solidifies. These pores can greatly reduce the finished material's strength and structural integrity, making it a less desirable product. The goal of the Pore Formation in Microgravity (PFMI) experiments was to learn how bubbles form and move during phase change (from liquid to solid) inside molten material, in this case succinonitrile (SCN), a clear organic compound that is a transparent metal analog material, and SCN water (1%) mixtures. The PFMI experiments methodically investigated pore formation and growth using SCN loaded with an excess amount of dissolved nitrogen gas. To eliminate the porosity problem in space processing, the role of thermocapillary forces in transporting the bubbles away from the solidification interface was examined. Experiments were conducted inside the MSG, a sealed and ventilated work volume in the U.S. Destiny laboratory. The samples were melted inside a thermal chamber with temperature-controlled hot zones and one thermoelectric cold zone. Flow visualization technology was used in support of the experiment to observe bubble movement.

Author

*Gravitational Effects; Directional Solidification (Crystals); Capillary Flow; Structural Failure; Porosity; Dissolved Gases; Microgravity*



**20070014515** StelSys, LLC, Baltimore, MD, USA

**StelSys Liver Cell Function Research (STELSYS)**

Li, Albert; International Space Station Research Summary Through Expedition 10; September 2006, pp. 73; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The liver filters potentially harmful substances from the blood and breaks these substances down into water-soluble forms that can be washed from the body. It is therefore a difficult organ to treat because medications can be broken down and removed before they have an opportunity to provide effective treatment. The purpose of this experiment was to allow the investigator to observe how human liver cells react to the presence of drugs in microgravity, and to compare these results to a control experiment conducted on the ground. To do this, human liver cells were launched inside a caddy held at freezing temperatures within a Dewar. The experiments were conducted in the CBOSS, including the BSTC, the gas supply module, and syringes. Individual cell cultures were grown in the temperature-controlled environment of the BSTC. When the experiments were complete, they were stored in the ARCTIC freezer until the end of the Expedition.

Author

*Liver; Cytology; Microgravity; Organs; Freezing; Cryogenic Equipment*

**20070014516** Washington Univ., Saint Louis, MO, USA

**Avian Development Facility (ADF), Two Investigations**

Dickman, J. David; Doty, Stephen B.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 64-65; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The avian development biology experiment, which is a tool for the study of embryogenesis in space, provides the support hardware needed for researchers to better understand and mitigate or nullify the forces of altered gravity on embryo development. Avian eggs are ideal for studying embryo development since they are self-contained and self-sustaining and can be nurtured without a maternal host. The Avian Development Facility (ADF) allows incubation of avian eggs under controlled conditions (humidity, temperature, and gas environment) on orbit and the fixation of the eggs for study while minimizing the effects of launch and landing. Up to 36 eggs in centrifuge carousels can be exposed to simulated gravity of zero-g to one-g in 0.1-g increments. During its flight on space shuttle mission STS-108 to the ISS, the ADF housed two investigations: the Development and Function of the Avian Otolith System in Normal and Altered Gravity Environments (ADF-Otolith) and the Skeletal Development in Embryonic Quail on the ISS (ADF-Skeletal) investigations.

Author

*Embryology; Musculoskeletal System; Otolith Organs; Reproduction (Biology); Gravitation; Embryos; Weightlessness*

**20070014517** Massachusetts Inst. of Tech., Cambridge, MA, USA

**Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions (INSPACE)**

Gast, Alice P.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 44; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Magnetorheological (MR) fluids are suspensions of magnetizable particles whose properties can be controlled by magnetic fields. These fluids are classified as 'smart materials' that transition to a solid-like state by the formation and cross-linking of microstructures in the presence of a magnetic field. On Earth these materials are used for vibration dampening systems that can be turned on or off. The Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsion (InSPACE) experiment will visually study the final, fine structure of MR fluids in a pulsed (alternating on and off) magnetic field. This study will help researchers understand the competing forces that govern the final shape of the structures. The InSPACE coil assembly holds a Helmholtz coil assembly containing sealed vials of MR fluid, the camera/lens assemblies, and the power control. The coil assembly is attached to the 'floor' of the MSG. The magnetic fields are applied to the various samples, and the operation of the experiment is monitored via video.

Author

*Magnetorheological Fluids; Magnetic Fields; Crosslinking; Solid State; Microstructure; Fine Structure*

**20070014520** California Univ., Irvine, CA, USA

**Protein Crystal Growth-Enhanced Gaseous Nitrogen (PCG-EGN)**

McPherson, Alexander; International Space Station Research Summary Through Expedition 10; September 2006, pp. 57; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The microgravity environment on board the ISS is relatively free from the effects of sedimentation and convection and



can provide an exceptional environment for crystal growth. Uniform, large, crystals are key for determining the structure of protein and other large biological molecules. The primary purpose of this experiment was to provide a simple trial platform for the production of a large number of crystals of various biological macromolecules. A second objective was an education program called 'Student Access to Space' in which students participated in preparing some of the samples that were flown on orbit and learned about crystallization, the methods of analysis of crystals, and the impact of studies of crystals on advancing biotechnology, medicine, and basic research in structural biology. Through the Student Access to Space program, more than 500 samples were mixed by middle and high schools across the USA. Protein Crystal Growth-Enhanced Gaseous Nitrogen (PCG-EGN) samples were brought to station frozen in liquid nitrogen in a Dewar (a stainless-steel and aluminum container assembly that is similar to a Thermos bottle) at -196 C (-321 F) in sealed plastic capillary tubes. On board ISS, the nitrogen warmed and boiled off, turning into a gas, and the samples began to thaw. After eight days, when the samples had reached the station ambient temperature of 22 C (71.6 F), crystals began to form.

Author

*Protein Crystal Growth; Microgravity; Liquid Nitrogen; Crystallization; Biotechnology; Macromolecules; Cryogenic Equipment*

**20070014521** Massachusetts Inst. of Tech., Cambridge, MA, USA

### **Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES)**

Miller, David; International Space Station Research Summary Through Expedition 10; September 2006, pp. 90; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

SPHERES is a testbed for formation flying by satellites, the theories and calculations that coordinate the motion of multiple bodies maneuvering in microgravity. To achieve this inside the ISS cabin, bowling-ball-sized spheres perform various maneuvers (or protocols), with one to three spheres operating simultaneously. The Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES) experiment will test relative attitude control and station-keeping between satellites, re-targeting and image plane filling maneuvers, collision avoidance and fuel balancing algorithms, and an array of geometry estimators used in various missions. SPHERES consists of three self-contained satellites, which are 18-sided polyhedrons that are 0.2 meter in diameter and weigh 3.5 kilograms. Each satellite contains an internal propulsion system, power, avionics, software, communications, and metrology subsystems. The propulsion system uses CO<sub>2</sub>, which is expelled through the thrusters. SPHERES satellites are powered by AA batteries. The metrology subsystem provides real-time position and attitude information. To simulate ground station-keeping, a laptop will be used to transmit navigational data and formation flying algorithms. Once these data are uploaded, the satellites will perform autonomously and hold the formation until a new command is given.

Author

*Formation Flying; Maneuvers; Collision Avoidance; Attitude Control; Microgravity*

**20070014522** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **In-space Soldering Experiment (ISSI)**

Grugel, Richard; International Space Station Research Summary Through Expedition 10; September 2006, pp. 88; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The In-space Soldering Experiment (ISSI) is another payload that was rapidly developed after the Columbia accident to provide a lowmass experiment using hardware already on board station. It was designed to promote understanding of joining techniques, shape equilibrium, wetting phenomena, and micro-structural development in space. Its primary objective was to better understand the effects and consequences of soldering in a microgravity environment such as that found on ISS. In Earth's gravity, soldering has a defined behavior and is reliant on gravity and convection to assist in solidification, joint shape, integrity, and microstructure. Unfortunately, on Earth detrimental gas bubbles (void spaces) are still found in the solder joint and at contact surfaces. These voids reduce the thermal and electrical conductivity and provide sites for crack initiation. Bubbles have less chance to escape in the reduced-gravity environment of space and, therefore, are likely to be more of a problem. To better understand this potential problem, a systematic series of soldering samples was designed to investigate and understand porosity development, surface wetting, and equilibrium shape formation. After the samples were heated on orbit, they were returned to Earth for property testing and metallographic examination.

Author

*Soldering; Surface Properties; Thermal Conductivity; Shapes; Payloads; Microgravity; Microstructure; Wetting*

**20070014523** Tulane Univ., New Orleans, LA, USA

### **Commercial Generic Bioprocessing Apparatus (CGBA), Three Investigations**

Hammond, Timothy G.; Keshishian, Haig; Stodlieck, Louis; Klaus, David; International Space Station Research Summary

Through Expedition 10; September 2006, pp. 70-71; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Commercial Generic Bioprocessing Apparatus (CGBA) provided automated processing for biological experiments. The CGBA can contain up to eight containers that house the experiments, and each container is programmable and temperature controlled between 4 C (39 F) and 37 C (99 F). The CGBA was equipped with data, video, and telemetry electronics to allow telepresence remote operation. Three experiments, KIDNEY CELL GENE EXPRESSION, SYNAPTOGENESIS IN MICROGRAVITY, and ANTIBIOTIC PRODUCTION IN SPACE, were conducted in the CGBA.

Author

*Bioprocessing; Microgravity; Gene Expression; Kidneys; Telemetry*

**20070014524** Deutsches Zentrum fuer Luft- und Raumfahrt e.V., Cologne, Germany

#### **Dosimetric Mapping (DOSMAP)**

Reitz, Guenther; International Space Station Research Summary Through Expedition 10; September 2006, pp. 32; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Dosimetric Mapping (DOSMAP) consisted of four types of dosimeters that measured absorbed dose, neutron dose, and heavy ion fluences as well as spectral composition with respect to charge, energy, and linear energy transfer (LET). Although the space program has produced a good deal of data on radiation since its beginning in the 1960s, there are insufficient data on radiation types and doses inside spacecraft. ISS provides an opportunity to fully characterize the nature and distribution of radiation over a long period of time. Nuclear tracking detector packages (NTDPs) measure the amount of radiation absorbed, the level of neutrons present, and the angle of entry into a variety of radiation-shielding materials. NTDPs were placed in different locations around ISS to monitor incoming radiation. Each package contained three strips of CR39 plastic film. As high-energy particles passed through the film, they left tracks that could be analyzed by researchers after NTDPs were returned to Earth. Dosimetry telescopes (DOSTELs), placed near each other in an empty rack, measured ion flow. Additionally, crewmembers used mobile dosimetry units (MDUs) as personal dosimeters. The control and interface unit (CIU) provided power for recharging the MDUs and an interface for downloading data to the HRF laptop. Twelve thermoluminescence dosimeters (TLDs) consist of a set of bulbs that measures dose rates for ionizing radiation and neutrons. Neutrons (low-energy, uncharged particles with the ability to penetrate deep into the body) are moderated by hydrogen. This means that neutrons can harm organs, such as the kidneys, that contain large quantities of hydrogen-containing water.

Author

*Dosimeters; Neutrons; Ionizing Radiation; Radiation Shielding; Polymeric Films; Thermoluminescence; Linear Energy Transfer (LET)*

**20070014526** Wisconsin Univ., Madison, WI, USA

#### **Advanced Astroculture (ADVASC)**

Zhou, Weijia; International Space Station Research Summary Through Expedition 10; September 2006, pp. 76-77; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Advanced Astroculture (AdvAsC) was a commercially sponsored payload that provided precise control of environmental parameters for plant growth, including temperature, relative humidity, light, fluid nutrient delivery, and carbon dioxide (CO<sub>2</sub>) and ethylene concentrations. AdvAsC hardware was used in a series of tests over three Expeditions (2, 4, and 5). First, AdvAsC demonstrated the first 'seed-to-seed' experiment in space, growing *Arabidopsis thaliana* through a complete life cycle. (*Arabidopsis thaliana* (thale cress) is a model system in plant biology studies with a short life cycle, a completely sequenced genome, and a history of space experiments.) Next, 35% of the space-grown seeds and 65% of wild *Arabidopsis* seeds were grown. Finally, soybean plants were also grown through an entire life cycle.

Author

*Plants (Botany); Spaceborne Experiments; Vegetation Growth; Humidity; Payloads; Carbon Dioxide Concentration; Soybeans; Life (Durability)*

**20070014527** Orbital Technologies Corp., Madison, WI, USA

#### **Biomass Production System (BPS)**

Morrow, Robert C.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 78; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Biomass Production System (BPS) was developed as a precursor to systems capable of maintaining plant growth in microgravity for more than 90 days (e.g., planetary missions). The BPS objective was to validate plant growth system

hardware functionality and performance, plant productivity and health, information acquisition, and experiment operations and support in microgravity. The BPS housed two experiments: the Technology Verification experiment and the Photosynthesis Experiment and System Testing and Operation (PESTO) experiment. Brassica rapa (field mustard) was the test species for the BPS. The BPS plant growth chambers (PGCs) contained plants that were started on the ground and that had already developed their photosynthetic apparatus, such as stoma, guard cells, and other structures found in the leaves. Samples taken from the plants were compared to data taken from previous ground-based experiments conducted using BPS. BPS tested the hypothesis that environmental control subsystems would provide a stress-free growing environment in microgravity. These technology validation studies provide a foundation on which to base the design of future plant growth units for station or future Exploration missions. These results can lead to the development of regenerative life support systems on future missions to the moon or Mars. While creating useful technology and science, BPS allowed students in grades Kindergarten through twelve to work as co-investigators on real space research. This research, known as 'Farming in Space,' examined the basic principles and concepts related to plant biology, agricultural production, ecology, and the space environment. Activities associated with this research encouraged curiosity in the sciences while teaching good scientific methodology.

Author

*Biomass; Vegetation Growth; Photosynthesis; Aerospace Environments; Agriculture; Ecology; Microgravity; Life Support Systems*

**20070014528** Japan Aerospace Exploration Agency, Tokyo, Japan

**Bonner Ball Neutron Detector (BBND)**

Goka, Tateo; International Space Station Research Summary Through Expedition 10; September 2006, pp. 30; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Radiation is one of the many risks faced by astronauts. Large doses of radiation, from increased solar activity or long-duration space travel, can damage and kill cells and tissue, cause cancer and eye cataracts, injure the central nervous system, reduce fertility, and alter genetics. Radiation monitoring devices have flown on shuttle missions and on the Russian Mir station, but these devices were designed to detect radiation affecting the body's exterior. Thermal neutrons account for up to 20% of radiation affecting low Earth orbit missions. In space or on other planets, where there is little or no atmosphere to act as a protective barrier, thermal neutrons can penetrate deep into the body, affecting blood-forming bone marrow. Also, thermal neutrons are moderated by hydrogen-rich materials, such as water, so they not only damage deep body structures but can also be stopped by organs with high-water composition, such as the kidneys, liver, and spleen. The Bonner Ball Neutron Detector (BBND), which initially flew on shuttle mission STS-89, was the first space-based experiment designed to specifically detect neutron radiation. BBND was also the first radiation experiment that allowed researchers to examine data while the experiment was still in orbit. Previous experiments required that the detection media be returned to Earth for analysis. BBND experiment hardware consists of two assemblies: the BBND control unit, which stores radiation measurements and controls data quality; and the BBND detector unit (DU), which measures neutron radiation via a series of six stainless steel spherical shells. Four spheres are thermal neutron detectors covered in polyethylene of different thickness, one detector is covered in gadolinium; and one detector is uncovered. The gadolinium-covered sphere acts as a control; neutrons are unable to penetrate the dense gadolinium, and the data collected by the sphere are used to determine the difference between pulses created by neutrons and protons. Data collected from the polyethylene-covered spheres will show how the amount of hydrogen surrounding the detector affects the amount of radiation penetration. BBND characterized the neutron radiation on ISS during Expeditions 2 and 3 and determined that galactic cosmic rays were the major cause of secondary neutrons measured inside ISS. The average dose-equivalent rate<sup>1</sup> observed through the investigation was 3.9 micro Sv/hour, with the highest rate at 96 micro Sv/hour, which occurred in the South Atlantic Anomaly region. Although this experiment did not characterize the neutron radiation environment outside of Earth's magnetic field, the BBND sampling equipment provided results without return of equipment to Earth and proved that similar measurement systems could be used on missions to the moon and Mars to monitor real-time radiation risks.

Author

*Neutron Counters; Extraterrestrial Radiation; International Space Station; Spaceborne Experiments; Space Missions*

**20070014529** NASA Johnson Space Center, Houston, TX, USA

**Expedition 3 (Aug 12, 2001 - Dec 12, 2001)**

International Space Station Research Summary Through Expedition 10; September 2006, pp. 118; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

As with other Expedition crews, the Expedition 3 crew focused on expansion and scientific matters. While various experiments naturally carried over from previous Expeditions thereby establishing a pattern of building on earlier work that

carries forward to this day the crew also conducted new experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB): Bonner Bell Neutron Detector (BR), Crewmember and Crew-Ground Interactions During International Space Station Missions (BR), Effect of Microgravity on the Peripheral Subcutaneous Veno-arteriolar Reflex in Humans (BR), Effects of Altered Gravity on Spinal Cord Excitability (BR), Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function (BR), Renal Stone Risk During Space Flight: Assessment and Countermeasure Validation (BR), Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (BR), Advanced Protein Crystallization Facility (PS), Cellular Biotechnology Operations Support System (PS), Dynamically Controlled Protein Crystal Growth (PS), Evaluation of Ovarian Tumor Cell Growth and Gene Expression (PS), Experiment Physics of Colloids in Space (PS), Human Renal Cortical Cell Differentiation and Hormone Production (PS), PC12 Pheochromocytoma Cells (PS), Materials International Space Station Experiment (SPD), Microgravity Acceleration Measurement System (SPD), Space Acceleration Measurement System-II (SPD), Crew Earth Observations (SF), and DreamTime (FSB).

Author

*Expeditions; Spaceborne Experiments; Bioastronautics; Space Flight; Exobiology; Physical Sciences; International Space Station*

**20070014530** NASA Johnson Space Center, Houston, TX, USA

**Expedition 4 (Dec 7, 2001 - Jun 15, 2002)**

International Space Station Research Summary Through Expedition 10; September 2006, pp. 119; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Expedition 4 three-man crew continued to maintain focus not only on ongoing experiments, several of which had already carried through Expeditions 2 and 3, but also turned their focus to new experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB). Or in the words of Carl Walz, this crew continued to make some headway: A Study of Radiation Doses Experienced by Astronauts in EVA (BR), Crewmember and Crew-Ground Interactions During International Space Station Missions (BR), Effect of Microgravity on the Peripheral Subcutaneous Veno-arteriolar Reflex in Humans (BR), Effects of Altered Gravity on Spinal Cord Excitability (BR), Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function (BR), Renal Stone Risk During Space Flight: Assessment and Countermeasure Evaluation (BR), Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (BR), Biomass Production System-Photosynthesis Experiment and Systems Testing (PS), Cellular Biotechnology Operations Support Systems (PS), Commercial Generic Bioprocessing Apparatus: Antibiotic Production in Space (PS), Commercial Protein Crystal Growth-High-Density (PS), Development and Function of the Avian Otolith System in Normal and Altered Gravity Environments (PS), Experiment Physics of Colloids in Space (PS), Protein Crystal Growth-Enhanced Gaseous Nitrogen Ewer (PS), Protein Crystal Growth-Single Locker Thermal Enclosure System (PS), Zeolite Crystal Growth Furnace (PS), Active Rack Isolation System ISS Characterization Experiment (SPD), Advanced Astroculture TM (SPD), Materials International Space Station Experiment (SPD), Microgravity Acceleration Measurement System (SPD), Space Acceleration Measurement System-II (SPD), Crew Earth Observations (SF), Earth Knowledge Acquired by Middle-School Students (FSB), and Education Payload Operations (FSB).

Author

*Expeditions; Spaceborne Experiments; Bioastronautics; Physical Sciences; Space Flight; Exobiology*

**20070014531** Centre National de la Recherche Scientifique, Strasbourg, France

**Advanced Protein Crystallization Facility (APCF), Eight Investigations**

Giege, Richard; Baumstark, Manfred W.; deGrip, Willem J.; Martial, Joseph; Otalora, Fermin; Weinkauf, Sevil; Wyns, Lode; Zagari, Adriana; International Space Station Research Summary Through Expedition 10; September 2006, pp. 52-53; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Understanding proteins is basic to understanding the processes of living things. While we know the chemical formulae of proteins, learning the chemical structure of these macromolecules is more difficult. Mapping the three-dimensional structure of proteins, DNA, ribonucleic acid (RNA), carbohydrates, and viruses provides information concerning their functions and behavior. This knowledge is fundamental to the emerging field of rational drug design, replacing the trial-and-error method of drug development. Microgravity provides a unique environment for growing crystals an environment that is free of the gravitational properties that can crush the delicate structures of crystals. Currently, several test facilities are used to grow crystals. The Advanced Protein Crystallization Facility (APCF) can support three crystal-growth methods: liquid-liquid diffusion, vapor diffusion, and dialysis. Liquid-liquid diffusion was not used during Expedition 3. In the vapor diffusion method, a crystal forms in a protein solution as a precipitant draws moisture in a surrounding reservoir. In the dialysis method,



salt draws moisture away from the protein solution via a membrane separating the two, forming crystals. ESA has announced that due to potential difficulties with the vapor diffusion method that could cause experiment failure, it will no longer propose the use of this method with the APCF. Initial analysis of crystals returned from station support the findings of earlier APCF flights: comparative crystallographic analysis indicates that space-grown crystals are superior in every way to control-group crystals grown on Earth under identical conditions (except the critical space environment). Crystals grown in microgravity generally have improved morphology, larger volume, higher diffraction limit, and lower mosaicity as compared to Earth-grown crystals. The researchers reported that the electron-density maps calculated from diffraction data contained considerably more detail, allowing them to produce more accurate three-dimensional models. Although many of the investigators have not completed their analysis and modeling, early published results have come out for crystals of (Pro-Pro-Gly)(sup 10) (PPG(sup 10)). PPG(sup 10) is a collagen protein found in many tissues. This collagen is particularly concentrated in the skin, joints, and bones. Video that was collected during Expedition 3 showed the small movements within the crystallizing solutions. A direct correlation between crystal motion and acceleration from events on station (such as docking, venting, and crew movement) was determined for the first time. The PPG(sup 10) crystals were independently studied by X-ray diffraction in various labs; the best resolution attained for microgravity- grown crystals from ISS was 1.5A, superior to the 1.7A obtained on the ground. The teams of APCF scientists are combining data from previous space flights, the ground, and the station to get the best possible information on protein structures for applications in pharmaceutical and physiological research.

Author

*Microgravity; Protein Crystal Growth; Space Processing; Research Facilities; Spaceborne Experiments; Test Facilities*

**20070014533** NASA Johnson Space Center, Houston, TX, USA

#### **Education Payload Operations (EPO)**

McArthur, Cynthia; International Space Station Research Summary Through Expedition 10; September 2006, pp. 106; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The objective of the Education Payload Operations (EPO) investigation is to use toys, tools, and other common items in the microgravity environment of ISS to create educational video and multimedia products that inspire the next generation of engineers, mathematicians, physicists, and other scientists. The products are used for demonstrations, and to support curriculum materials that are distributed across the USA and internationally. The individual EPO projects are designed to explore physical phenomena such as force, motion, and energy. Each Expedition involves different on-orbit activities and themes, as well as different partners, such as museums, universities, and public school districts. The EPO payloads are small, weighing less than 6.8 kg (15 lbs) each. Whenever possible, the demonstrations use materials and objects already available on station. Some of the activities cover physical properties, such as Newton's Laws of Motion or Bernoulli's Principle for air pressure, and others are specific to life in space, such as explaining how ISS solar panels work or demonstrating EVAs. Specific activities are as follows: Education demonstration activities (EDAs) showed basic physics, such as of Weight vs. Mass, Center of Mass. EDAs illustrated aspects of living in space, such as Tools in Space, and Pouring Liquid into a Container. International Toys in Space developed a DVD for use in classrooms around the USA based on the physics behind a variety of toys. Tomatosphere II, exposed 1.5 million tomato seeds to the space environment. The seeds have been distributed to classrooms throughout Canada. Students will measure the germination rates, growth patterns, and vigor of growth of the seeds. EDAs for use by science museums included a harmonica, puzzles, dexterity puzzles, and a balsa wood Wright Flyer. EPO has been a successful education program on ISS. By using simple objects and the microgravity environment, NASA is able to produce videos that demonstrate physical properties, such as force, motion, and energy, that may be obscured by gravity on Earth. To date, over 500 videos, DVDs, and video clips have been produced and distributed to science teachers and schools throughout the USA. About 1500 teachers each year are trained to use the materials in their classrooms. An additional 30.9 million students have had the opportunity to participate in live downlink events where their classmates pose questions of ISS crews on orbit. The 1.5 million Tomatosphere-II seeds from Expedition 9 were divided and distributed to 160,000 students in 6000 classrooms across Canada.

Author

*Payloads; International Space Station; Educational Resources; Science; Multimedia; Education; Microgravity*

**20070014534** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Space Experiment Module (SEM)**

Lewis, Ruthan; International Space Station Research Summary Through Expedition 10; September 2006, pp. 107; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Space Experiment Module (SEM) provides high school students with an opportunity to conduct research on the



effects of microgravity, radiation, and space flight on various materials. Research objectives for each experiment are determined by students but generally include hypotheses on changes in selected materials due to the space environment. This is achieved by providing students space capsules that contain passive test articles for flight. These capsules are clear, sealable polycarbonate vials, 1 inch in diameter and 3 inches in depth. The vials are packed in satchels (20 per satchel) that contain special formed foam layers for flight. Students select the items that will be contained inside the vials. Some of the items include seeds, such as corn, watermelon, cucumber, beans, peas, and several other vegetables. Additional items include materials, such as wool, Kevlar, silk, ultraviolet beads, chicken bones, copper, plastic, dextrose, yeast, over-the-counter medications, human hair, mineral samples, light bulbs, and brine shrimp eggs. Many students will test for seed growth after microgravity exposure; other students will test how materials protect against radiation exposure and survival rates of microscopic life forms. Eleven schools and 300 students developed experiments for SEM Satchel 001. The satchel was launched during ISS Expedition 10 in December 2004 and returned to Earth on space shuttle Discovery (STS-114) in August 2005. The sample vials will be returned to the students for analysis.

Derived from text

*Spaceborne Experiments; Education; Microgravity; Space Flight; International Space Station; Extraterrestrial Radiation; Organic Materials; Life Sciences*

**20070014535** Anacapa Sciences, Inc., Santa Barbara, CA, USA

**Behavioral Issues Associated with Isolation and Confinement: Review and Analysis of ISS Crew Journals (JOURNALS)**

Stuster, Jack W.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 28; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

A previous content analysis of journals maintained during long-duration expeditions on Earth (e.g., to the Antarctic) provided quantitative data on which to base a rank-ordering of behavioral issues in terms of importance. Journals uses the same content evaluation techniques on journals kept by ISS crewmembers. The objective is to identify equipment, habitat, and procedural features that can help humans when adjusting to isolation and confinement while ensuring they remain effective and productive during future long-duration space flights. While on orbit, crewmembers make journal entries at least three times a week in a personal journal. In format, their journal can be either electronic (i.e., using an ISS laptop) or paper. In addition to the journal entries, participating crewmembers also complete a brief electronic questionnaire at the mid-point of their Expeditions. Studies on Earth have shown that analyzing the content of journals and diaries is an effective means of identifying issues that are most important to the person recording his or her thoughts. The method is based on the assumption that the frequency with which an issue is mentioned in a journal reflects the importance of that issue or category to the writer. The tone of each entry (positive, negative, or neutral) and phase of the Expedition are also variables of interest. Study results will lead to recommendations for the design of equipment, facilities, procedures, and training to help sustain behavioral adjustment and performance during long-duration Expeditions on ISS, or to the moon, Mars, and beyond. These studies can also assist on Earth with Antarctic missions, service on submarines, etc. anywhere humans choose to work in confinement or isolation.

Author

*Space Flight; Confinement; Crews; Habitats; Isolation*

**20070014536** NASA Johnson Space Center, Houston, TX, USA

**Crew Earth Observations (CEO)**

Lulla, Kamlesh; Runco, Sue; International Space Station Research Summary Through Expedition 10; September 2006, pp. 100-102; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Space station crewmembers use handheld cameras and a variety of lenses (including an 800mm lens equivalent) to take Earth observation photographs. Scientists on the ground train the crew in basic areas of Earth system science and provide to the crew a daily list of targets of the greatest scientific interest. Crewmembers takes these photographs as time is available and during their leisure time. These digital photographs are downlinked and their location identified for use as educational and research tools, as well as historical records of global environmental change, special geological and weather events, and the growth and change of human-made features, such as cities. Crew Earth Observations (CEO) can be conducted from any available window on space station, but is conducted primarily from the nadir-viewing, optical-quality window in the U.S. Destiny laboratory module and from the windows in the Russian Zvezda service module.

Author

*Spacecrews; Earth Observations (From Space); Earth Sciences; Geology; Space Stations; Service Module (ISS)*

**20070014537** California Univ., San Diego, La Jolla, CA, USA

**Earth Knowledge Acquired by Middle School Students (EARTHKAM)**

Ride, Sally; International Space Station Research Summary Through Expedition 10; September 2006, pp. 103-104; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Earth Knowledge Acquired by Middle School Students (EarthKAM) is a NASA-sponsored education program that enables thousands of students to photograph and examine Earth from the unique perspective of space. The purpose of EarthKAM is to integrate the excitement of ISS with middle-school education. EarthKAM invites schools from around the world to take advantage of this exceptional educational opportunity. In addition to the many schools in the USA, schools from 12 countries have also participated. Middle-school students learn about spacecraft orbits and Earth photography, and then target and request their desired images by tracking the orbit of the station, referencing maps and atlases, and checking weather. Their requests are then collected and compiled by students at the University of California, San Diego, Calif. With help from representatives at NASA Johnson Space Center in Houston, compiled requests are uplinked to a computer on board ISS. This computer records the requests and transmits them to the digital camera, which takes the desired images and transfers them back to the computer. The images are then downlinked to EarthKAM computers on the ground. Within hours, the EarthKAM team makes the photographs available on the World Wide Web for easy access by participating schools as well as the general public. Schools then explore the images in support of national, state, and local education standards. Students learn to recognize and research features in the images, place the images in global context using maps and atlases, and make connections with the topics and subjects they are studying.

Author

*Digital Cameras; Spacecraft Orbits; Photographs; Education; Students; Photography*

**20070014538** California Univ., San Francisco, CA, USA

**Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (SUBREGIONAL BONE)**

Lang, Thomas F.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 16; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Bone loss is one of the known risks of exposure to reduced gravity, a risk that increases with the length of stay in that environment. Although healthy bone can repair damage done to itself, researchers are yet unsure how much bone is replaced after crewmembers return to Earth. Is bone mass recovered one year after flight? Is there a difference in the subregional distribution of bone prior to flight and one year after flight? Subregional Bone measured the amount of bone lost during space flight and recovered postflight in an effort to answer these questions. Subregional Bone hardware consisted of several devices used before and after flight. Dual-energy X-ray absorptiometry (DEXA) provided a two-dimensional measurement of the entire bone mass of the hip, spine, and heel. These measurements were compared to quantitative computed tomography (QCT), which examined cortical (the bone's dense outer layer) and trabecular (the bone's inner, spongy looking layer) bone separately and three-dimensionally to determine the extent of bone loss in the hip and spine. QCT measurements allow researchers to determine whether loss is localized in a subregion of the bone. DEXA and QCT measurements were also compared to quantitative ultrasound (QUS) of the heel to evaluate ultrasound as a possible alternative to X-ray measurements.

Author

*Bone Demineralization; Musculoskeletal System; Bone Mineral Content; Microgravity; Exposure; X Ray Sources*

**20070014539** NASA Johnson Space Center, Houston, TX, USA

**Expedition 7 (Apr 28, 2003 - Oct 27, 2003)**

Lu, Edward T.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 122; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Expedition 7 crew was the first two-man crew to occupy space station, and the first crew to launch from Baikonur on board a Soyuz spacecraft. Despite the loss of one-third of the expected crew complement, this crew continued work to fulfill ISS's scientific goals, conducting experiments in bioastronautics research (BR), physical science (PS), space product development (SPD), space flight (SF), and fundamental space biology (FSB): Chromosomal Aberrations in Bloody Lymphocytes of Astronauts (BR), Crewmember and Crew-Ground Interactions During International Space Station Missions (BR), Effect of Prolonged Space Flight on Human Skeletal Muscle (BR), Hand Posture Analyzer (BR), Promoting Sensorimotor Response Generalizability (BR), Subregional Assessment of Bone Loss in the Axial Skeleton in Long-term Space Flight (BR), Coarsening in Solid Liquid Mixtures-2 (PS), Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions (PS), Protein Crystal Growth-Single Locker Thermal Enclosure System (PS), Toward Understanding Pore Formation and Mobility During Controlled Directional Solidification in a Microgravity Environment (PS), In-space Soldering Experiment (SPD), Materials International Space Station Experiment (SPD), Microgravity Acceleration

Measurement System (SPD), Space Acceleration Measurement System-II (SPD), Crew Earth Observations (SF), Earth Knowledge Acquired by Middle School Students (FSB), and Education Payload Operations (FSB).

Author

*Bioastronautics; Expeditions; International Space Station; Physical Sciences; Spaceborne Experiments; Exobiology; Space Flight*

**20070014540** NASA Johnson Space Center, Houston, TX, USA

#### **Medical Monitoring of ISS Crewmembers**

International Space Station Research Summary Through Expedition 10; September 2006, pp. 111; In English; See also 20070014486; Copyright; Avail.: CASI: [A01](#), Hardcopy

Medical monitoring of ISS crewmembers includes tests before, during, and after space flight to follow the effects of space flight on their health and to ensure that they receive proper medical care. Nutritional assessments ensure adequate intake of energy, protein, and vitamins during missions. Scientists use the information to understand the connections between nutrition and human health during space flight, and to develop effective dietary strategies to reduce adverse health impacts. Electrocardiograms or Holter monitor tracings obtained from astronauts during their time in space are analyzed to provide insight into cardiac function in microgravity. In addition, some assessments of new hardware such as the ultrasound equipment, mass-measurement devices, and gas analyzers have led to scientific findings. Results of nutritional status monitoring were compiled and analyzed for crewmembers on ISS Expeditions 1-8. Intake of energy (relative to World Health Organization standards) was observed to generally decrease over time during missions. However, when dietary counseling was provided to a single astronaut during flight, adequate energy intake was thereafter maintained throughout the mission. Body weight, total bone mineral content, and bone mineral density decreased during flight. Antioxidant capacity decreased during flight, leading to increased susceptibility to genetic damage from radiation. Vitamin D concentration in crew bone was decreased, and bone resorption increased by long exposure to microgravity (Smith et al. 2005). Future flight research is in development to acquire more information on the effect of the space flight environment on vitamin and drug potency, and to gather additional information on the importance of nutrition as a countermeasure for the effects of space flight on the human body. A very limited retrospective study of electrocardiograms (ECGs) from astronauts on short-duration (space shuttle) and long-duration (ISS and Mir) missions indicated that long-duration, not short-duration, space flight was associated with prolonged cardiac conduction and repolarization. Long-duration flight was associated with heart-rate-corrected objective test interval (QTc) interval prolongation that might increase susceptibility to cardiac arrhythmia (D'Annunzio et al. 2003). A systematic collection of ECGs from ISS crewmembers is planned for the future to better evaluate whether there is a significant risk of arrhythmia from long-duration stays in a microgravity environment. As part of the testing of ultrasound equipment when it was first brought to ISS, the Focused Assessment with Sonography for Trauma (FAST) examinations were performed by an ISS crewmember with minimal sonography training. Even with a significantly reduced video frame rate and a two-second communication latency, the quality of the ultrasound video were excellent and would have allowed clinical decision-making in a trauma contingency (Sargsyan et al. 2005). This preliminary work was followed by the formal ADUM experiment.

Author

*International Space Station; Nutrition; Expeditions; Aerospace Medicine; Manned Space Flight; Spacecrews*

**20070014541** NASA Johnson Space Center, Houston, TX, USA

#### **Environmental Monitoring of ISS**

International Space Station Research Summary Through Expedition 10; September 2006, pp. 110; In English; See also 20070014486; Copyright; Avail.: CASI: [A01](#), Hardcopy

Environmental monitoring research has been performed on all ISS Expeditions and will continue to be performed on future station missions to ensure the health of the spacecraft as well as of the crew. During one study of the ISS atmosphere 12 bacterial strains were isolated and fingerprinted from the ISS water system. These bacteria consisted of common strains and were encountered at levels below 10,000 colony-forming units per 10 square centimeters, well below the minimum of bacteria needed to cause illness. These data represent the beginning of ISS habitation and indicate that the lessons learned from previous Mir and Skylab missions were implemented and have been effective in keeping station a safe place in which to live and work (Castro et al. 2004). Other studies performed an in-depth microbial examination of the drinking water in various stages (from the NASA Kennedy Space Center, Cape Canaveral, Fla. to the ISS ports). These studies have revealed that NASA policy for biocide treatment has effectively removed pathogenic microbes traveling to space (La Duc et al. 2004; Plumlee et al. 2002; Plumlee et al. 2003). Studies on station air quality found that the active (volatile organics analyzer) and passive

(HEPA filters) controls in place on ISS are effective in controlling trace contaminants of volatile organic compounds on space station (James 2003; Perry 2003).

Author

*Environmental Monitoring; International Space Station; Health Physics; Expeditions*

**20070014544** NASA Johnson Space Center, Houston, TX, USA

**Microencapsulation of Anti-tumor Drugs (MEPS)**

Morrison, Dennis; International Space Station Research Summary Through Expedition 10; September 2006, pp. 72; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The microencapsulation electrostatic processing system (MEPS) is an automated system that is used to produce liquid-filled microballoons. It works through the use of microcapsules, unique capsules resembling miniature liquid-filled balloons the size of blood cells, that deliver FDA-approved anti-cancer drugs by injection into the bloodstream. The microgravity environment on ISS is vital to the development of these capsules because the station environment enables the pharmaceutical and its outer membrane to form spontaneously. MEPS was designed with flexibility in mind. The system can process a wide range of experiments. For example, it can handle volumetric proportions of up to six chemical constituents; it can transfer liquids back and forth, at variable rates, between its six reservoirs and two main chambers; it can apply different electrical fields to the enclosed experiments; and it can be programmed to use filters or membranes of different porosity between chambers. Electrical fields charge the surface of the microcapsules, making it less recognizable as a foreign invader to the immune system. The use of microcapsules will benefit the treatment of several diseases. For example, to eliminate daily insulin shots diabetes patients can use implanted microcapsules as treatment. A further Earth application is the microcapsules can be used as a substitution for chemotherapy. Traditional anti-cancer treatment involves large quantities of drugs that affect the entire body. The microcapsules contain a smaller dose of medication that directly targets tumors. Also, they reduce the unwanted side effects currently produced by chemotherapy. MEPS experiments were conducted during Expedition 5. Eight samples were processed using various methods to mix dissimilar liquids to form micro-balloons/microcapsules. The recovered micro-balloons were analyzed for size and drug content. Additionally, studies included the effects of temperature and internal pressure on the size of the micro-balloons. Ground-based medical investigations revealed that when using these microcapsules, the growth of human prostate and lung tumors can be inhibited with only a few local injections. When anti-cancer microcapsules are injected following cryosurgery, the combined treatment can completely destroy 1- to 2-cm-size tumors in just three weeks.

Author

*Pharmacology; Tumors; Encapsulating; Space Processing; Electrostatics*

**20070014545** Henry Ford Health System, Detroit, MI, USA

**Advanced Diagnostic Ultrasound in Microgravity (ADUM)**

Dulchavsky, Scott A.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 18-19; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Advanced Diagnostic Ultrasound in Microgravity (ADUM) tests the accuracy of using ultrasound technology in the novel clinical situation of space flight. This investigation includes assessing health problems in the eyes and bones, as well as sinus infections and abdominal injuries. ADUM further tests the feasibility of using an in-flight ultrasound to monitor bone density during long-duration space flights. Another objective of the experiment is determining how well nonmedical crewmembers can learn to use an ultrasound device with CD-ROM training manuals and remote guidance from Earth. The intent of the ADUM investigation is to develop methods by which an individual who is untrained in medicine can use an ultrasound machine with remote diagnostician assistance to evaluate a vast array of medical problems. Expedition crews used the ISS HRF ultrasound machine and four scan sets: the cardio/thoracic scan, which focuses on the heart but also can scan the lungs; the abdominal/retroperitoneal scan, which focuses on the organs of the abdomen, including the liver, spleen, kidneys, and bladder; the dental scan, which can image the mouth, teeth, gums, facial bones and sinuses, and eyes; and the bone scan, which images bones and characterizes bone loss during flight. In addition to the ultrasound machine and probes, another key component of ADUM on station is the on-board proficiency enhancer a software application that is used to train crewmembers on the methods employed for each scan.

Author

*Ultrasonic Tests; Bone Demineralization; Microgravity; Infectious Diseases; Bone Mineral Content*



**20070014546** California Univ., San Francisco, CA, USA

**Crewmember and Crew-Ground Interaction During International Space Station Missions (INTERACTIONS)**

Kansas, Nick A.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 26-27; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Isolated in the microgravity and vacuum of near-Earth orbit, ISS is a potentially dangerous place in which to work and live. Mission success and crew safety rely on the ability of station crews to communicate and get along with their fellows, regardless of their age, gender, nationality, or personal beliefs and preferences. It is also critical that the station crew has good interactions with members of ground operations. The Interactions study recorded crew and crew-ground activities in an effort to fully understand group dynamics, individual psychological health, and factors that both hinder and help daily life on station. The study consisted primarily of a computerized questionnaire filled out weekly by crewmembers in space and by ground personnel at the NASA Johnson Space Center, the NASA Marshall Space Flight Center, and the Russian Mission Control Center in Moscow. The questionnaire software included a series of questions from three standard mood and interpersonal group climate questionnaires as well as a critical incident log.

Author

*Spacecrews; Ground Operational Support System; Microgravity; Flight Control; Group Dynamics*

**20070014547** Northeastern Univ., Boston, MA, USA

**Zeolite Crystal Growth (ZCG)**

Sacco, Albert, Jr.; International Space Station Research Summary Through Expedition 10; September 2006, pp. 49; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Zeolites, which are mineral crystals of aluminosilicates, have a rigid crystalline structure with a network of interconnected tunnels and cages that is similar to a honeycomb. A sort of mineral sponge, zeolites have the ability to absorb and release liquids and gases such as petroleum or hydrogen while remaining as hard as rock. Zeolites are important for many industrial processes, and are used as commercial ion exchangers, adsorbents, and catalysts. Virtually all the world's gasoline is produced or upgraded using zeolites. Zeotype ETS titanosilicates contain natural quantum wires in their structures, which are of great potential in electronic and optical applications and in photochemistry. There is insufficient understanding of how zeolite and zeotype materials grow, however, making it difficult for scientists to independently control structure characteristics such as size, morphology, and purity. Growing zeolite crystals in microgravity minimizes the role of convection and sedimentation, and may allow production of crystals with fewer defects. The Zeolite Crystal Growth (ZCG) furnace, which was designed for the and derived from earlier shuttle models, can grow zeolites, zeotype titanosilicate materials, ferroelectrics, and silver halides - all materials of commercial interest. The unit consists of a cylinder-shaped furnace, the Improved Zeolite Electronic Control System (IZECS), which includes a touchpad and data display as well as autoclaves. Two precursor growth solutions are placed into each autoclave, which mix during their stay in the furnace. Zeolite Beta was grown from precursor solutions of sodium aluminate and colloidal silica heated to 403 K (130 C) on station. The samples were characterized by X-ray diffraction to determine the crystal structure. The performance of zeolite Beta as a Lewis acid catalyst was evaluated using a standard set of chemical reduction reactions known as the Meerwein-Pohhdorf-Verley (MPV) reactions.

Author

*Zeolites; Aluminates; Crystal Structure; Honeycomb Structures; Photochemical Reactions; Microgravity; Hydrogen*

**20070014551** NASA Glenn Research Center, Cleveland, OH, USA

**Microgravity Acceleration Measurement System (MAMS) and Space Acceleration Measurement System II (SAMS-II), Two Investigations**

DeLombard, Richard; International Space Station Research Summary Through Expedition 10; September 2006, pp. 97-98; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Apparent weightlessness is created as the station circles and falls around the Earth; its continuous free-fall simulates the absence of gravity. A number of scientific investigations on station rely on the absence of gravity for successful completion. However, tiny disturbances aboard ISS, including the reboosts required to maintain the station's orbit, mimic the effects of gravity. Vibrational disturbances occur within the frequency range of 0.01-300 Hz. Two different hardware systems measure and record these vibrations. SAMS-II measures vibrations from vehicle acceleration, systems operations, crew movements, and thermal expansion and contraction. The microgravity acceleration measurement system (MAMS) complements the data by recording accelerations caused by aerodynamic drag and ISS movements caused by small attitude adjustments, gravity gradient, and the venting of water. These quasi-steady state accelerations occur in the frequency range below 1 Hz. MAMS consists of a low-frequency triaxial accelerometer, the miniature electro-static accelerometer (MESA), a high-frequency accelerometer, the high-resolution accelerometer package (HiRAP), and associated computer, power, and signal processing



subsystems contained within a double middeck locker enclosure. SAMS-II has multiple remote triaxial sensor (RTS) systems that are used to monitor individual experiments. Each RTS is capable of measuring between 0.01 Hz to beyond 300 Hz of vibration, also known as g-jitter.

Author

*Acceleration Measurement; Microgravity; Gravitational Effects; Weightlessness; Vibration; Accelerometers; Free Fall*

**20070014552** Air Force Research Lab., Kirkland AFB, NM, USA

**Middeck Active Control Experiment-II (MACE-II)**

Ninneman, R. Rory; International Space Station Research Summary Through Expedition 10; September 2006, pp. 96; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Middeck Active Control Experiment-II (MACE-II) will allow engineers to design future spacecraft and facilities with lightweight, inexpensive structures and materials without sacrificing the stability demanded by sensitive payloads. MACE-II, the first hands-on experiment on board station, consists of two basic parts designed to detect and compensate for vibrations. The multi-body platform (MBP) test article, which is the structure undergoing tests, has four 1-inch-diameter struts connected to five nodes. It is loosely tethered in the aisle between racks during operations and is stowed between operations. The entire platform has 20 separate sensors that monitor vibration. The experiment support module (ESM) is a self-contained computer with a power interface to the EXPRESS rack and an umbilical connection to the MBP. During experiments scientists used a gimbal on the MBP to create a disturbance at one end of the platform. The ESM detected these movements and, using an adaptable set of algorithms, calculated the opposing forces to be applied at the opposite gimbal, thereby stabilizing the platform. The algorithms could be adapted to changes due to moving parts, variations in temperature, and normal wear and tear on mechanical systems. A collaborating team at MIT planned to study how control systems such as that used for MACE-II can be applied to hardware and systems that change over time, such as telescopes, antennas, and robotic arms that must be moved to perform specific duties.

Author

*Active Control; Stabilization; Robot Arms; Vibration; Struts; Payloads*

**20070014553** Alabama Univ., Birmingham, AL, USA

**Commercial Generic Protein Crystal Growth-High Density (CPCG-H)**

DeLucas, Lawrence; International Space Station Research Summary Through Expedition 10; September 2006, pp. 54-55; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Proteins provide the building blocks of our bodies. Some proteins make it possible for red blood cells to carry oxygen while other proteins help transmit nerve impulses that allow us to see, hear, smell, and touch. Still other proteins play crucial roles in causing diseases. Pharmaceutical companies may be able to develop new or improved drugs to fight those diseases once the exact structure of the proteins are known. The goal of the Commercial Protein Crystal Growth High-density (CPCG-H) payload is to grow high-quality crystals of selected proteins so that their molecular structures can be studied. On Earth, gravity often has a negative impact on growing protein crystals. In microgravity, however, gravitational disturbances are removed, thus allowing some crystals to grow in a more regular and perfect form. During ISS Expeditions 2 and 4, CPCG-H was outfitted with High-density Protein Crystal Growth (HDPCG) hardware. HDPCG was a vapor-diffusion facility that could process as many as 1008 individual protein samples. The entire HDPCG assembly had four trays that held 252 protein crystal growth blocks, each consisting of six chambers. The chambers had a protein reservoir, a precipitant reservoir, and an optically clear access cap. The chambers were designed to reduce sedimentation problems and to produce highly uniform, single crystals. The primary proteins involved in the testing of the CPCG-H hardware during ISS Expeditions 2 and 4 were mistletoe lectin-I (ML-I), *Thermus flavus* 5S RNA, brefeldin A-ADP ribosylated substrate (BARS), and a triple mutant myoglobin (Mb-YQR). ML-I is a ribosome inactivating protein that can stop protein biosynthesis (creation of proteins) in cells, and is also a major component of drugs used in the treatment of cancer. Although the study of *Thermus flavus* 5S RNA has been ongoing for well over 30 years, the exact function of this protein remains obscure. Scientists believe that the crystallization of different domains of this protein may reveal functional properties. BARS is an enzyme involved in membrane fission, catalyzing the formation of phosphatidic acid by transfer. Mb-YQR was studied to assess the functional role of packing defects in proteins. The elucidation of these protein structures will provide valuable insight into the role of these proteins for application in the pharmaceutical industry.

Derived from text

*Protein Crystal Growth; International Space Station; Spaceborne Experiments; Expeditions; Density (Mass/Volume); Life Sciences*

**20070014554** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Fluid Merging Viscosity Measurement (FMVM)**

Ethridge, Edwin; International Space Station Research Summary Through Expedition 10; September 2006, pp. 42; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Fluid Merging Viscosity Measurement (FMVM) experiment was developed rapidly after the Columbia accident to provide a low-mass experiment using hardware already on board ISS. The purpose of FMVM is to measure the rate of coalescence of two highly viscous liquid drops and correlate the results with liquid viscosity and surface tension. The FMVM experiment will verify a new method for measuring the viscosity of highly viscous liquids by measuring the time it takes for two spheres of liquid to coalesce into a single spherical drop, where the time constant is proportional to the viscosity. If this new method of measuring viscosity is validated, it could provide a method by which to measure viscosities of materials that cannot currently be measured. An example of this is liquid (molten) glass that crystallizes while cooling from liquid to solid. The viscosity in most of the crystallization range cannot be measured using current, Earth-based technology in spite of the fact that this is the most interesting range for the study of crystallization.

Author

*Viscosity; Coalescing; Drops (Liquids); Interfacial Tension; Liquid Surfaces*

**20070014555** Alabama Univ., Birmingham, AL, USA

**Dynamically Controlled Protein Crystal Growth (DCPCG)**

DeLucas, Lawrence; International Space Station Research Summary Through Expedition 10; September 2006, pp. 56; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Researchers have found that it is possible to grow high-quality protein crystals in the weightlessness of low Earth orbit, where gravitational forces will not distort or destroy a crystal's delicate structure. When crystals are returned to Earth, their structure is examined by sending X rays through them and using the resulting data to create computer-based models. The goal of the Dynamically Controlled Protein Crystal Growth (DCPCG) experiment was to control and improve the crystallization process by dynamically controlling the elements that influence crystal growth. Current growth methods provide little or no control over growth rate and separation of the nucleation and growth phases. The DCPCG system provided researchers real-time control of the diffusion process (supersaturation) through control of the protein concentration. It also determined the differences in vapor diffusion rates (the speed at which the liquid surrounding a protein solution evaporates, leaving behind a protein crystal) between experiments conducted in microgravity and similar experiments conducted on Earth. DCPCG quantified the basic differences between crystal growth on Earth and in space, differences in growth rate and in the way crystals moved and organized in the two environments, thereby allowing researchers to assess in detail the best systems with which to grow high-quality crystals and how to optimize those systems.

Author

*Protein Crystal Growth; Low Earth Orbits; Microgravity; Crystal Structure; Gravitational Effects; Diffusion*

**20070014556** Rensselaer Polytechnic Inst., Troy, NY, USA

**Solidification Using Baffle in Sealed Ampoules (SUBSA)**

Ostrogorsky, Alexander; International Space Station Research Summary Through Expedition 10; September 2006, pp. 48; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Material melt-growth experiments have been difficult to run in the space environment because there is just enough residual micro-acceleration (g-jitter) to produce natural convection that interferes with the structure and purity of the material. This convection is responsible for the lack of reliable and reproducible solidification data and, thus, for gaps in the solidification theory. The Solidification Using Baffle in Sealed Ampoules (SUBSA) experiment tested an automatically moving baffle (driven by melt expansion during freezing) that was designed to reduce thermal convection inside an ampoule to determine whether the baffle significantly reduces convection. Ground studies showed that the baffle reduces the movement of the material during its liquid phase, making the process easier to analyze and allowing more homogenous crystals to form. The key goal of SUBSA was to clarify the origin of the melt convection in space and to reduce the magnitude to the point that it does not interfere with the transport phenomena.

Author

*Ampoules; Crystal Growth; Melts (Crystal Growth); Transport Properties; Free Convection; Liquid Phases; Baffles*

**20070014557** New Century Pharmaceuticals, Inc., Huntsville, AL, USA

**Protein Crystal Growth-Single Locker Thermal Enclosure System (PCG-STES) Nine Investigations**

Carter, Daniel; International Space Station Research Summary Through Expedition 10; September 2006, pp. 58-61; In English; See also 20070014486; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

The Protein Crystal Growth-Single Locker Thermal Enclosure System (PCG-STES) is a suite of protein crystal growth investigations performed in the station s U.S. Destiny laboratory. Multiple independent and collaborating principal investigators contributed samples and evaluated the technology for crystal growth in space. In general these studies sought to grow crystals of target proteins that would be of superior quality to similar crystals grown on the ground. The sedimentation and convection forces that cause many Earth-grown crystals to be irregular in shape and small in size are absent in microgravity.

Author

*Protein Crystal Growth; Destiny Laboratory Module; Microgravity; Proteins; Geodesy*

**20070014606** NASA Ames Research Center, Moffett Field, CA, USA, Eloret Corp., Sunnyvale, CA, USA

**2nd International Planetary Probe Workshop**

Venkatapathy, Ethiraj; Martinez, Ed; Arcadi, Marla; April 2005; 368 pp.; In English; 2nd International Planetary Probe Workshop, 23-27 Aug. 2004, Moffett Field, CA, USA; See also 20070014607 - 20070014676; Original contains color and black and white illustrations

Contract(s)/Grant(s): WU 800-92-00

Report No.(s): NASA/CP-2004-213456; A-0513522; Copyright; Avail.: CASI: [A16](#), Hardcopy

Included are presentations from the 2nd International Planetary Probe Workshop. The purpose of the second workshop was to continue to unite the community of planetary scientists, spacecraft engineers and mission designers and planners; whose expertise, experience and interests are in the areas of entry probe trajectory and attitude determination, and the aerodynamics/aerothermodynamics of planetary entry vehicles. Mars lander missions and the first probe mission to Titan made 2004 an exciting year for planetary exploration. The Workshop addressed entry probe science, engineering challenges, mission design and instruments, along with the challenges of reconstruction of the entry, descent and landing or the aerocapture phases. Topics addressed included methods, technologies, and algorithms currently employed; techniques and results from the rich history of entry probe science such as PAET, Venera/Vega, Pioneer Venus, Viking, Galileo, Mars Pathfinder and Mars MER; upcoming missions such as the imminent entry of Huygens and future Mars entry probes; and new and novel instrumentation and methodologies.

Author

*Space Probes; Aerospace Vehicles; Nanotechnology; Atmospheric Entry; Gas Giant Planets; Space Missions*

**20070014607** NASA Ames Research Center, Moffett Field, CA, USA

**Pascal: A Mars Climate Network Mission**

Haberle, Bob; Zent, Aaron; 2nd International Planetary Probe Workshop; April 2005; 16 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on Pascal: A Mars Climate Network Mission is shown.

CASI

*Climate; Mars Environment; Space Missions; Communication Networks*

**20070014608** NASA Ames Research Center, Moffett Field, CA, USA

**NASA Outer Solar System Exploration**

Bergstrahl, Jay T.; 2nd International Planetary Probe Workshop; April 2005; 22 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on NASA's Outer Solar System Exploration is shown. The topics include: 1) Completed Missions; 2) Operating Missions; 3) Missions in Development; and 4) Future Missions.

CASI

*Gas Giant Planets; Solar System; Space Exploration; NASA Space Programs; Space Missions*

**20070014609** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Direct Communication to Earth from Probes**

Bolton, Scott J.; Folkner, William M.; Abraham, Douglas S.; 2nd International Planetary Probe Workshop; April 2005; 13 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on outer planetary probe communications to Earth is shown. The topics include: 1) Science Rational for Atmospheric Probes to the Outer Planets; 2) Controlling the Scientific Appetite; 3) Learning more about Jupiter before we send more probes; 4) Sample Microwave Scan From Juno; 5) Jupiter s Deep Interior; 6) The Square Kilometer

Array (SKA): A Breakthrough for Radio Astronomy; 7) Deep Space Array-based Network (DSAN); 8) Probe Direct-to-Earth Data Rate Calculations; 9) Summary; and 10) Enabling Ideas.

CASI

*Space Probes; Communication; Solar System; Gas Giant Planets*

**20070014610** Centre National de la Recherche Scientifique, Paris, France

**ESA's Mars Program: European Plans for Mars Exploration**

Forget, Francois; 2nd International Planetary Probe Workshop; April 2005; 43 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on the European Space Agency Mars Exploration Program is shown. The topics include: 1) History:Mars Exploration in Europe; 2) A few preliminary results from Mars Express; 3) A new instrument:Radar MARSIS; and 4) European Mars Exploration in the future?

CASI

*European Space Agency; Mars Exploration; Mission Planning; European Space Programs*

**20070014611** NASA Ames Research Center, Moffett Field, CA, USA

**A Survey of the Rapidly Emerging Field of Nanotechnology: Potential Applications for Scientific Instruments and Technologies for Atmospheric Entry Probes**

Meyyappan, M.; Arnold, J. O.; 2nd International Planetary Probe Workshop; April 2005, pp. 289-290; In English; See also 20070014606; Copyright; Avail.: CASI: [A01](#), Hardcopy

The field of Nanotechnology is well funded worldwide and innovations applicable to Solar System Exploration are emerging much more rapidly than thought possible just a few years ago. This presentation will survey recent innovations from nanotechnology with a focus on novel applications to atmospheric entry science and probe technology, in a fashion similar to that presented by Arnold and Venkatapathy at the previous workshop forum at Lisbon Portugal, October 6-9, 2003. Nanotechnology is a rapidly emerging field that builds systems, devices and materials from the bottom up, atom by atom, and in so doing provides them with novel and remarkable macro-scale performance. This technology has the potential to revolutionize space exploration by reducing mass and simultaneously increasing capability. Thermal, Radiation, Impact Protective Shields: Atmospheric probes and humans on long duration deep space missions involved in Solar System Exploration must safely endure 3 significant hazards: (i) atmospheric entry; (ii) radiation; and (iii) micrometeorite or debris impact. Nanostructured materials could be developed to address all three hazards with a single protective shield, which would involve much less mass than a traditional approach. The concept can be ready in time for incorporation into NASA's Crew Exploration Vehicle, and possible entry probes to fly on the Jupiter Icy Moons

Author

*Atmospheric Entry; Environmental Monitoring; Space Exploration; Hypervelocity Impact; Micrometeorites; Atmospheric Sounding; Meteorite Collisions*

**20070014612** NASA Ames Research Center, Moffett Field, CA, USA

**Pico Reentry Probes: Affordable Options for Reentry Measurements and Testing**

Ailor, William H.; Kapoor, Vinod B.; Allen, Gay A., Jr.; Venkatapathy, Ethiraj; Arnold, James O.; Rasky, Daniel J.; 2nd International Planetary Probe Workshop; April 2005, pp. 291-300; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

It is generally very costly to perform in-space and atmospheric entry experiments. This paper presents a new platform - the Pico Reentry Probe (PREP) - that we believe will make targeted flight-tests and planetary atmospheric probe science missions considerably more affordable. Small, lightweight, self-contained, it is designed as a 'launch and forget' system, suitable for experiments that require no ongoing communication with the ground. It contains a data recorder, battery, transmitter, and user-customized instrumentation. Data recorded during reentry or space operations is returned at end-of-mission via transmission to Iridium satellites (in the case of earth-based operations) or a similar orbiting communication system for planetary missions. This paper discusses possible applications of this concept for Earth and Martian atmospheric entry science. Two well-known heritage aerodynamic shapes are considered as candidates for PREP: the shape developed for the Planetary Atmospheric Experiment Test (PAET) and that for the Deep Space II Mars Probe.

Author

*Atmospheric Entry; Space Probes; Space Missions; Flight Tests; Planetary Atmospheres; Atmospheric Sounding; Environmental Monitoring; Mars Atmosphere*



**20070014613** NASA Ames Research Center, Moffett Field, CA, USA

**[Now, The Time for Probes and In-Situ Science]**

Hubbard, G. Scott; 2nd International Planetary Probe Workshop; April 2005; 16 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph explaining the need for probes and in situ measurements to understand data from extra solar planet studies is shown. The topics include: 1) To explore the universe and search for life: Probes in Context; 2) What is a probe?; 3) NASA Ames Research Center-founded 1939; 4) Past & Present: Successful Probes and Fly-by's; 5) Thermal Protection Materials and Arc-Jet Facility; 6) Mars Exploration Rovers-Spirit & Opportunity; 7) Bio/Info/Nanotechnology; 8) Technology for Exploration; 9) Award Winning NASA Research Park; 10) Where we need to go; and 11) The Future: Pico Probes

CASI

*In Situ Measurement; Space Probes; Nanotechnology; Mars Exploration; Extrasolar Planets; Space Exploration*

**20070014614** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Technology Development for NASA Mars Missions**

Hayati, Samad; 2nd International Planetary Probe Workshop; April 2005; 22 pp.; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on technology development for NASA Mars Missions is shown. The topics include: 1) Mars mission roadmaps; 2) Focus and Base Technology programs; 3) Technology Infusion; and 4) Feed Forward to Future Missions.

Author

*Mars Missions; NASA Programs; Technology Utilization; Mars Exploration*

**20070014616** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands  
**Re-Entry Simulation and Landing Area for YES2**

Calzada, Silvia; 2nd International Planetary Probe Workshop; April 2005; 9 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The REST simulator includes many parameters: a) Inertial  $\psi$ - $\phi$  Fix to Earth reference system; b) Geodetic  $\psi$ - $\phi$  Geocentric coordinates; c) Rotational velocity of the Atmosphere; d) Effect of the rotation of the Earth; e) Bulge effect of the Earth; f) Spherical harmonic expansion for the Earth's gravitational potential,  $J_2$  (zonal); g) Heat flux, temperature in the wall; h) Drag coefficient for different regimes; i) Flow regime status; j) Density model NRLMSISE-00; k) Wind model HWM-93; l) G2S atmospheric model with the latest meteorological conditions and m) Landing area (Monte Carlo Simulations)

Derived from text

*Reentry; Simulators; Heat Flux; Aerodynamic Drag; Gravitational Fields; Geocentric Coordinates*

**20070014617** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Neutral Mass Spectrometry for Venus Atmosphere and Surface**

Mahaffy, Paul; 2nd International Planetary Probe Workshop; April 2005; 28 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

The assignment is to make precise (better than 1 %) measurements of isotope ratios and accurate (5-10%) measurements of abundances of noble gas and to obtain vertical profiles of trace chemically active gases from above the clouds all the way down to the surface. Science measurement objectives are as follows: 1) Determine the composition of Venus atmosphere, including trace gas species and light stable isotopes; 2) Accurately measure noble-gas isotopic abundance in the atmosphere; 3) Provide descent, surface, and ascent meteorological data; 4) Measure zonal cloud-level winds over several Earth days; 5) Obtain near-IR descent images of the surface from 10-km altitude to the surface; 6) Accurately measure elemental abundances & mineralogy of a core from the surface; and 7) Evaluate the texture of surface materials to constrain weathering environment.

Author

*Mass Spectroscopy; Venus (Planet); Venus Atmosphere; Venus Surface; Atmospheric Composition; Trace Contaminants; Surface Properties; Planetary Composition; Isotope Ratios*

**20070014618** NASA Ames Research Center, Moffett Field, CA, USA

**Validation of Afterbody Aeroheating Predictions for Planetary Probes: Status and Future Work**

Wright, Michael J.; Brown, James L.; Sinha, Krishnendu; Candler, Graham V.; Milos, Frank S.; Prabhu, Dinesh K.; 2nd International Planetary Probe Workshop; April 2005, pp. 275-286; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy



A review of the relevant flight conditions and physical models for planetary probe afterbody aeroheating calculations is given. Readily available sources of afterbody flight data and published attempts to computationally simulate those flights are summarized. A current status of the application of turbulence models to afterbody flows is presented. Finally, recommendations for additional analysis and testing that would reduce our uncertainties in our ability to accurately predict base heating levels are given.

Author

*Afterbodies; Aerodynamic Heating; Base Heating; Flight Conditions*

**20070014619** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Deep Space Network Capabilities for Receiving Weak Probe Signals**

Asmar, Sami; Johnston, Doug; Preston, Robert; 2nd International Planetary Probe Workshop; April 2005; 19 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Planetary probes can encounter mission scenarios where communication is not favorable during critical maneuvers or emergencies. Launch, initial acquisition, landing, trajectory corrections, safing. Communication challenges due to sub-optimum antenna pointing or transmitted power, amplitude/frequency dynamics, etc. Prevent lock-up on signal and extraction of telemetry. Examples: loss of Mars Observer, nutation of Ulysses, Galileo antenna, Mars Pathfinder and Mars Exploration Rovers Entry, Descent, and Landing, and the Cassini Saturn Orbit Insertion. A Deep Space Network capability to handle such cases has been used successfully to receive signals to characterize the scenario. This paper will describe the capability and highlight the cases of the critical communications for the Mars rovers and Saturn Orbit Insertion and preparation radio tracking of the Huygens probe at (non-DSN) radio telescopes.

Author

*Deep Space Network; Ulysses Mission; Radio Tracking; Mars Pathfinder; Mars Observer; Galileo Spacecraft; Huygens Probe; Radio Telescopes*

**20070014620** Tennessee Univ., Knoxville, TN, USA

**An Investigation of Aerogravity Assist at Titan and Triton for Capture into Orbit About Saturn and Neptune**

Ramsey, Philip; Lyne, James Evans; 2nd International Planetary Probe Workshop; April 2005, pp. 49-57; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

Previous work by our group has shown that an aerogravity assist maneuver at the moon Titan could be used to capture a spacecraft into a closed orbit about Saturn if a nominal atmospheric profile at Titan is assumed. The present study extends that work and examines the impact of atmospheric dispersions, variations in the final target orbit and low density aerodynamics on the aerocapture maneuver. Accounting for atmospheric dispersions substantially reduces the entry corridor width for a blunt configuration with a lift-to-drag ratio of 0.25. Moreover, the choice of the outbound hyperbolic excess speed (with respect to Titan) strongly influences the corridor width. Given the influence of these two parameters, certain mission scenarios may be feasible using a blunt aeroshell, while other mission designs would likely require a biconic vehicle with a higher lift-to-drag ratio. Preliminary simulations indicate that the same technique may be feasible for capture into orbit about Neptune using the tenuous atmosphere of Triton.

Author

*Aeroassist; Aerocapture; Neptune (Planet); Titan; Saturn (Planet); Triton*

**20070014621** NASA Ames Research Center, Moffett Field, CA, USA

**Aerothermodynamic Testing of Aerocapture and Planetary Probe Geometries in Hypersonic Ballistic-Range Environments**

Wilder, M. C.; Reda, D. C.; Bogdanoff, D. W.; Olejniczak, J.; 2nd International Planetary Probe Workshop; April 2005; 5 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

A viewgraph presentation on aerothermodynamic testing of aerocapture and planetary probe design methods in hypersonic ballistic range environments is shown. The topics include: 1) Ballistic Range Testing; 2) NASA-Ames Hypervelocity Free Flight Facility; and 3) Representative Results.

CASI

*Aerocapture; Aerothermodynamics; Space Probes; Hypersonic Flight; Ballistic Ranges; Reacting Flow*

**20070014622** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **Technology for Entry Probes**

Cutts, James A.; Arnold, James; Venkatapathy, Ethiraj; Kolawa, Elizabeth; Munk, Michelle; Wercinski, Paul; Laub, Bernard; 2nd International Planetary Probe Workshop; April 2005; 35 pp.; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph describing technologies for entry probes is presented. The topics include: 1) Entry Phase; 2) Descent Phase; 3) Long duration atmospheric observations; 4) Survivability at high temperatures; and 5) Summary.

CASI

*Technology Utilization; Space Probes; Atmospheric Entry; Space Missions; Aerospace Environments*

**20070014624** NASA Ames Research Center, Moffett Field, CA, USA

### **Could Nano-Structured Materials Enable the Improved Pressure Vessels for Deep Atmospheric Probes?**

Srivastava, D.; Fuentes, A.; Bienstock, B.; Arnold, J. O.; 2nd International Planetary Probe Workshop; April 2005; 18 pp.; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on the use of Nano-Structured Materials to enable pressure vessel structures for deep atmospheric probes is shown. The topics include: 1) High Temperature/Pressure in Key X-Environments; 2) The Case for Use of Nano-Structured Materials Pressure Vessel Design; 3) Carbon based Nanomaterials; 4) Nanotube production & purification; 5) Nanomechanics of Carbon Nanotubes; 6) CNT-composites: Example (Polymer); 7) Effect of Loading sequence on Composite with 8% by volume; 8) Models for Particulate Reinforced Composites; 9) Fullerene/Ti Composite for High Strength-Insulating Layer; 10) Fullerene/Epoxy Composite for High Strength-Insulating Layer; 11) Models for Continuous Fiber Reinforced Composites; 12) Tensile Strength for Discontinuous Fiber Composite; 13) Ti + SWNT Composites: Thermal/Mechanical; 14) Ti + SWNT Composites: Tensile Strength; and 15) Nano-structured Shell for Pressure Vessels.

CASI

*Nanostructure Growth; Pressure Vessel Design; Space Probes; Carbon Nanotubes; Mechanical Properties; Composite Materials*

**20070014625** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **The Huygens Mission to Titan: Overview and Status**

Lebreton, Jean-Pierre; Matson, Dennis; 2nd International Planetary Probe Workshop; April 2005; 49 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A general overview and status of the Huygens Mission to Titan is presented.

CASI

*General Overviews; Titan; Space Missions; Huygens Probe; Cassini Mission; NASA Space Programs*

**20070014626** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

### **The Venus SAGE Atmospheric Structure Investigation**

Colaprete, Anthony; Crisp, Dave; LaBaw, Clayton; Morse, Stephanie; 2nd International Planetary Probe Workshop; April 2005; 12 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Experiment goals and objectives are: a) To accurately define the state properties as a function of altitude from below the 10(exp -4) mb level (approx.150 km) to 92 bars (surface); b) To measure the stability of the atmosphere, and identify convective layers and stable layers, where they exist; c) To detect cloud levels from changes in the lapse rate at their boundaries; d) To provide state properties within the cloud levels, and thus provide supplementary information on cloud composition; e) To search for and characterize wave structure within the atmosphere; f) To search for and measure the intensity and scale of turbulence; g) To measure descent and surface wind speed and direction; h) To provide Lander altitude and attitude during decent for descent imaging analysis; and i) To provide a back-up landing sensor.

Author

*Venus (Planet); Atmospheric Stratification; Wind Velocity; Turbulence; Attitude (Inclination); Convection; Stability*

**20070014627** NASA Ames Research Center, Moffett Field, CA, USA

### **Synergy Between Entry Probes and Orbiters**

Young, Richard E.; 2nd International Planetary Probe Workshop; April 2005, pp. 225-232; In English; See also 20070014606; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

We identify two categories of probe-orbiter interactions which benefit the science return from a particular mission. The first category is termed 'Mission Design Aspects'. This category is meant to describe those aspects of the mission design involving the orbiter that affect the science return from the probe(s). The second category of probe-orbiter interaction is termed 'Orbiter-Probe Science Interactions', and is meant to include interactions between orbiter and probe(s) that directly involve science measurements made from each platform. Two mission related aspects of probe-orbiter interactions are delivery of a probe(s) to the entry site(s) by an orbiter, and communication between each probe and the orbiter. We consider four general probe-orbiter science interactions that greatly enhance, or in certain cases are essential for, the mission science return. The four topics are, global context of the probe entry site(s), ground truth for remote sensing observations of an orbiter, atmospheric composition measurements, and wind measurements.

Author

*Space Probes; Orbits; Remote Sensing; Atmospheric Composition; Ground Truth*

**20070014628** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Atmospheric Models for Aeroentry and Aeroassist**

Justus, C. G.; Duvall, Aleta; Keller, Vernon W.; 2nd International Planetary Probe Workshop; April 2005, pp. 41-48; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

Eight destinations in the Solar System have sufficient atmosphere for aeroentry, aeroassist, or aerobraking/aerocapture: Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune, plus Saturn's moon Titan. Engineering-level atmospheric models for Earth, Mars, Titan, and Neptune have been developed for use in NASA's systems analysis studies of aerocapture applications. Development has begun on a similar atmospheric model for Venus. An important capability of these models is simulation of quasi-random perturbations for Monte Carlo analyses in developing guidance, navigation and control algorithms, and for thermal systems design. Characteristics of these atmospheric models are compared, and example applications for aerocapture are presented. Recent Titan atmospheric model updates are discussed, in anticipation of applications for trajectory and atmospheric reconstruct of Huygens Probe entry at Titan. Recent and planned updates to the Mars atmospheric model, in support of future Mars aerocapture systems analysis studies, are also presented.

Author

*Aeroassist; Aerobraking; Aerocapture; Atmospheric Models; Titan; Uranus (Planet); Earth (Planet); Venus (Planet); Mars (Planet); Mars Atmosphere*

**20070014629** NASA Ames Research Center, Moffett Field, CA, USA

#### **Neptune Polar Orbiter with Probes**

Bienstock, Bernard; Atkinson, David; Baines, Kevin; Mahaffy, Paul; Steffes, Paul; Atreya, Sushil; Stern, Alan; Wright, Michael; Willenberg, Harvey; Smith, David; Frampton, Robert; Sichi, Steve; Peltz, Leora; Masciarelli, James; VanCleve, Jeffrey; 2nd International Planetary Probe Workshop; April 2005, pp. 29-39; In English; See also 20070014606; Original contains color illustrations

Contract(s)/Grant(s): NNNH04CC41C; Copyright; Avail.: CASI: [A03](#), Hardcopy

The giant planets of the outer solar system divide into two distinct classes: the gas giants Jupiter and Saturn, which consist mainly of hydrogen and helium; and the ice giants Uranus and Neptune, which are believed to contain significant amounts of the heavier elements oxygen, nitrogen, and carbon and sulfur. Detailed comparisons of the internal structures and compositions of the gas giants with those of the ice giants will yield valuable insights into the processes that formed the solar system and, perhaps, other planetary systems. By 2012, Galileo, Cassini and possibly a Jupiter Orbiter mission with microwave radiometers, Juno, in the New Frontiers program, will have yielded significant information on the chemical and physical properties of Jupiter and Saturn. A Neptune Orbiter with Probes (NOP) mission would deliver the corresponding key data for an ice giant planet. Such a mission would ideally study the deep Neptune atmosphere to pressures approaching and possibly exceeding 1000 bars, as well as the rings, Triton, Nereid, and Neptune's other icy satellites. A potential source of power would be nuclear electric propulsion (NEP). Such an ambitious mission requires that a number of technical issues be investigated, however, including: (1) atmospheric entry probe thermal protection system (TPS) design, (2) probe structural design including seals, windows, penetrations and pressure vessel, (3) digital, RF subsystem, and overall communication link design for long term operation in the very extreme environment of Neptune's deep atmosphere, (4) trajectory design allowing probe release on a trajectory to impact Neptune while allowing the spacecraft to achieve a polar orbit of Neptune, (5) and finally the suite of science instruments enabled by the probe technology to explore the depths of the Neptune atmosphere. Another driving factor in the design of the Orbiter and Probes is the necessity to maintain a fully operational flight system during the lengthy transit time from launch through Neptune encounter, and throughout the mission. Following our response to the recent NASA Research Announcement (NRA) for Space Science Vision Missions for mission studies by NASA for implementation in the

2013 or later time frame, our team has been selected to explore the feasibility of such a Neptune mission.

Author

*Neptune (Planet); Polar Orbits; Space Missions; Space Probes; Solar System; Uranus (Planet)*

**20070014630** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Project Prometheus and Future Entry Probe Missions**

Spilker, Thomas R.; 2nd International Planetary Probe Workshop; April 2005; 14 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on project Prometheus and future entry probe missions is shown. The topics include: 1) What Is Project Prometheus?; 2) What Capabilities Can Project Prometheus Offer? What Mission Types Are Being Considered?; 3) Jupiter Icy Moons Orbiter (JIMO); 4) How Are Mission Opportunities Changing?; 5) Missions Of Interest a Year Ago; 6) Missions Now Being Considered For Further Study; 7) Galileo-Style (Conventional) Probe Delivery; 8) Galileo-Style Probe Support; 9) Conventional Delivery and Support of Multiple Probes; 10) How Entry Probe Delivery From an NEP Vehicle Is Different; and 11) Concluding Remarks.

Derived from text

*Prometheus; Space Probes; Space Missions; NASA Space Programs*

**20070014631** Korea Advanced Inst. of Science and Technology, Daejeon, Korea, Republic of

**Calculation of H<sub>2</sub>-He Flow with Nonequilibrium Ionization and Radiation: an Interim Report**

Furudate, Michiko; Chang, Keun-Shik; 2nd International Planetary Probe Workshop; April 2005, pp. 99-106; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

The nonequilibrium ionization process in hydrogen-helium mixture behind a strong shock wave is studied numerically using the detailed ionization rate model developed recently by Park which accounts for emission and absorption of Lyman lines. The study finds that, once the avalanche ionization is started, the Lyman line is self-absorbed. The intensity variation of the radiation at 5145 Angstroms found by Leibowitz in a shock tube experiment can be numerically reproduced by assuming that ionization behind the shock wave prior to the onset of avalanche ionization is 1.3%. Because 1.3% initial ionization is highly unlikely, Leibowitz's experimental data is deemed questionable. By varying the initial electron density value in the calculation, the calculated ionization equilibration time is shown to increase approximately as inverse square-root of the initial electron density value. The true ionization equilibration time is most likely much longer than the value found by Leibowitz.

Author

*Helium; Hydrogen; Nonequilibrium Ionization; Radiation Absorption; Mathematical Models; Computational Fluid Dynamics*

**20070014632** Global Aerospace Corp., Altadena, CA, USA

**HyperPASS, a New Aeroassist Tool**

Gates, Kristin; McRonald, Angus; Nock, Kerry; 2nd International Planetary Probe Workshop; April 2005, pp. 251-256; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

A new software tool designed to perform aeroassist studies has been developed by Global Aerospace Corporation (GAC). The Hypersonic Planetary Aeroassist Simulation System (HyperPASS) [1] enables users to perform guided aerocapture, guided ballute aerocapture, aerobraking, orbit decay, or unguided entry simulations at any of six target bodies (Venus, Earth, Mars, Jupiter, Titan, or Neptune). HyperPASS is currently being used for trade studies to investigate (1) aerocapture performance with alternate aeroshell types, varying flight path angle and entry velocity, different gload and heating limits, and angle of attack and angle of bank variations; (2) variable, attached ballute geometry; (3) railgun launched projectile trajectories, and (4) preliminary orbit decay evolution. After completing a simulation, there are numerous visualization options in which data can be plotted, saved, or exported to various formats. Several analysis examples will be described.

Author

*Aeroassist; Software Development Tools; Hypersonics; Aerocapture; Aerobraking; Ballutes; Trajectories; Orbit Decay; Flight Paths*

**20070014633** NASA Ames Research Center, Moffett Field, CA, USA

**Thermal, Radiation and Impact Protective Shields (TRIPS) for Robotic and Human Space Exploration Missions**

Loomis, M. P.; Arnold, J. L.; 2nd International Planetary Probe Workshop; April 2005, pp. 325-334; In English; See also 20070014606; Original contains color illustrations

Contract(s)/Grant(s): NAS2-03144; NAG2-1580; Copyright; Avail.: CASI: [A02](#), Hardcopy



New concepts for protective shields for NASA's Crew Exploration Vehicles (CEVs) and planetary probes offer improved mission safety and affordability. Hazards include radiation from cosmic rays and solar particle events, hypervelocity impacts from orbital debris/ micrometeorites, and the extreme heating environment experienced during entry into planetary atmospheres. The traditional approach for the design of protection systems for these hazards has been to create single-function shields, i.e. ablative and blanket-based heat shields for thermal protection systems (TPS), polymer or other low-molecular-weight materials for radiation shields, and multilayer, Whipple-type shields for protection from hypervelocity impacts. This paper introduces an approach for the development of a single, multifunctional protective shield, employing nanotechnology-based materials, to serve simultaneously as a TPS, an impact shield and as the first line of defense against radiation. The approach is first to choose low molecular weight ablative TPS materials, (existing and planned for development) and add functionalized carbon nanotubes. Together they provide both thermal and radiation (TR) shielding. Next, impact protection (IP) is furnished through a tough skin, consisting of hard, ceramic outer layers (to fracture the impactor) and sublayers of tough, nanostructured fabrics to contain the debris cloud from the impactor before it can penetrate the spacecraft's interior.

Author

*Thermal Protection; Radiation Shielding; Robotics; Space Exploration; Space Missions; Heat Shielding; Ablative Materials; Impactors; Thermal Radiation*

**20070014634** Eloret Corp., Sunnyvale, CA, USA

**Performance of a Light-Weight Ablative Thermal Protection Material for the Stardust Mission Sample Return Capsule**

Covington, M. A.; 2nd International Planetary Probe Workshop; April 2005, pp. 257-268; In English; See also 20070014606 Contract(s)/Grant(s): NAS2-99092; Copyright; Avail.: CASI: [A03](#), Hardcopy

New tests and analyses are reported that were carried out to resolve testing uncertainties in the original development and qualification of a lightweight ablative material used for the Stardust spacecraft forebody heat shield. These additional arcjet tests and analyses confirmed the ablative and thermal performance of low density Phenolic Impregnated Carbon Ablator (PICA) material used for the Stardust design. Testing was done under conditions that simulate the peak convective heating conditions (1200 W/cm<sup>2</sup> and 0.5 atm) expected during Earth entry of the Stardust Sample Return Capsule. Test data and predictions from an ablative material response computer code for the in-depth temperatures were compared to guide iterative adjustment of material thermophysical properties used in the code so that the measured and predicted temperatures agreed. The PICA recession rates and maximum internal temperatures were satisfactorily predicted by the computer code with the revised properties. Predicted recession rates were also in acceptable agreement with measured rates for heating conditions 37% greater than the nominal peak heating rate of 1200 W/sq cm. The measured in-depth temperature response data show consistent temperature rise deviations that may be caused by an undocumented endothermic process within the PICA material that is not accurately modeled by the computer code. Predictions of the Stardust heat shield performance based on the present evaluation provide evidence that the maximum adhesive bondline temperature will be much lower than the maximum allowable of 250 C and an earlier design prediction. The re-evaluation also suggests that even with a 25 percent increase in peak heating rates, the total recession of the heat shield would be a small fraction of the as-designed thickness. These results give confidence in the Stardust heat shield design and confirm the potential of PICA material for use in new planetary probe and sample return applications.

Author

*Heat Shielding; Thermal Protection; Stardust Mission; Sample Return Missions; Atmospheric Entry; Ablative Materials; Convective Heat Transfer; Endothermic Reactions; Thermophysical Properties; Temperature Effects*

**20070014635** NASA Ames Research Center, Moffett Field, CA, USA

**Development and Test Plans for the MSR EEV**

Dillman, Robert; Laub, Bernard; Kellas, Sotiris; Schoenenberger, Mark; 2nd International Planetary Probe Workshop; April 2005, pp. 269-274; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI:

[A02](#), Hardcopy

The goal of the proposed Mars Sample Return mission is to bring samples from the surface of Mars back to Earth for thorough examination and analysis. The Earth Entry Vehicle is the passive entry body designed to protect the sample container from entry heating and deceleration loads during descent through the Earth's atmosphere to a recoverable location on the surface. This paper summarizes the entry vehicle design and outlines the subsystem development and testing currently planned in preparation for an entry vehicle flight test in 2010 and mission launch in 2013. Planned efforts are discussed for the areas



of the thermal protection system, vehicle trajectory, aerodynamics and aerothermodynamics, impact energy absorption, structure and mechanisms, and the entry vehicle flight test.

Author

*Aerothermodynamics; Mars Sample Return Missions; Mars Surface; Atmospheric Entry; Earth Atmosphere; Thermal Protection; Aerodynamic Heating; Deceleration*

**20070014637** NASA Johnson Space Center, Houston, TX, USA

#### **Family System of Advanced Charring Ablators for Planetary Exploration Missions**

Congdon, William M.; Curry, Donald M.; 2nd International Planetary Probe Workshop; April 2005; 18 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Advanced Ablators Program Objectives: 1) Flight-ready(TRL-6) ablative heat shields for deep-space missions; 2) Diversity of selection from family-system approach; 3) Minimum weight systems with high reliability; 4) Optimized formulations and processing; 5) Fully characterized properties; and 6) Low-cost manufacturing. Definition and integration of candidate lightweight structures. Test and analysis database to support flight-vehicle engineering. Results from production scale-up studies and production-cost analyses.

Derived from text

*Ablative Materials; Heat Shielding; Cost Analysis; Reliability; Ablation*

**20070014638** NASA Langley Research Center, Hampton, VA, USA

#### **MER EDL: Overview and Reconstruction Status**

Desai, Prasun N.; Lee, Wayne J.; 2nd International Planetary Probe Workshop; April 2005; 24 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

An overview and reconstruction of the Mars Exploration Rover (MER) Entry Descent and Landing (EDL) is shown. The topics include: 1) Background; 2) MER Candidate Landing Sites; 3) MER Entry Heritage w/Viking & Mars Pathfinder; 4) MER EDL Animation; 5) MER Entry, Descent, and Landing (EDL) Sequence; 6) Pre-Entry Spirit Entry Atmosphere Models; 7) Spirit Landing Ellipse at Final OD, & Updated Estimate Differenced 1-way Doppler; 8) Spirit Landing Ellipse at Final OD and Final Location Estimates; 9) Monte Carlo Results for Spirit ; 10) Reconstructed and refined Spirit Entry Density Profile; 11) Mars Pathfinder Attitude Reconstruction; 12) Spirit Attitude Reconstruction; 13) Spirit Entry Ground Track; 14) Reconstructed Spirit Terminal Descent Dynamics (Side View); 15) Opportunity Landing Ellipse at Final OD, & Updated Estimate Differenced 1-way Doppler; 16) Spirit Landing Ellipse at Final OD and Final Location Estimates; 17) Monte Carlo Results for Opportunity; 18) Reconstructed Opportunity Entry Density Profile; and 19) Opportunity Attitude Reconstruction. CASI

*General Overviews; Mars Roving Vehicles; Mars Exploration; Descent; Atmospheric Entry; Mars Landing*

**20070014639** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

#### **Mars Science Laboratory Overview and MSL EDL Challenges**

Umland, Jeffrey W.; 2nd International Planetary Probe Workshop; April 2005; 15 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

An overview of Mars Science Laboratory (MSL) Entry, Descent and Landing (EDL) challenges is presented. The topics include: 1) MSL Project Overview; 2) Mars Science Laboratory Top Level Schedule (Single Launch); 3) EDL Challenges; 4) MSL Surface System; 5) Mars Rover Wheel Family Tree; 6) Gusev Comparisons; 7) Mars Surface Accessibility; 8) Atlas V 401 Launch Performance; 9) Parachute Deployment Altitude Variation with Time of Year and Latitude; 10) Dust Storms and Winds; 11) Nominal MSL EDL Timeline; and 12) Specific EDL Challenges.

CASI

*Descent; Mars Surface; General Overviews; Mars Landing; Atmospheric Entry; NASA Space Programs*

**20070014640** Lockheed Martin Space Systems Co., Sunnyvale, CA, USA

#### **Software Risk Identification for Interplanetary Probes**

Dougherty, Robert J.; Papadopoulos, Periklis E.; 2nd International Planetary Probe Workshop; April 2005, pp. 59-67; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

The need for a systematic and effective software risk identification methodology is critical for interplanetary probes that are using increasingly complex and critical software. Several probe failures are examined that suggest more attention and resources need to be dedicated to identifying software risks. The direct causes of these failures can often be traced to systemic

problems in all phases of the software engineering process. These failures have led to the development of a practical methodology to identify risks for interplanetary probes. The proposed methodology is based upon the tailoring of the Software Engineering Institute's (SEI) method of taxonomy-based risk identification. The use of this methodology will ensure a more consistent and complete identification of software risks in these probes.

Author

*Risk; Software Engineering; Space Probes; Interplanetary Spacecraft*

**20070014641** Arizona Univ., Tucson, AZ, USA

**The Instrumented Frisbee(Registered TradeMark) as a Prototype for Planetary Entry Probes**

Lorenz, Ralph D.; 2nd International Planetary Probe Workshop; April 2005, pp. 317-324; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

A Frisbee has been equipped with sensors, batteries and micro-controllers for data acquisition to record its translational accelerations and attitude motion. The experiments explore the capabilities and limitations of sensors on a rapidly-rotating platform moving in air, and illustrate several of the complex gyrodynamic aspects of frisbee flight. The experiments constitute an instructive exercise in aerospace vehicle systems integration and in attitude reconstruction.

Author

*Atmospheric Entry; Prototypes; Attitude (Inclination); Data Acquisition; Translational Motion; Systems Integration; Aerospace Vehicles*

**20070014642** Instituto Superior Tecnico, Lisbon, Portugal

**Study of Some Planetary Atmospheres Features by Probe Entry and Descent Simulations**

Gil, P. J. S.; Rosa, P. M. B.; 2nd International Planetary Probe Workshop; April 2005, pp. 181-186; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

Characterization of planetary atmospheres is analyzed by its effects in the entry and descent trajectories of probes. Emphasis is on the most important variables that characterize atmospheres e.g. density profile with altitude. Probe trajectories are numerically determined with ENTRAP, a developing multi-purpose computational tool for entry and descent trajectory simulations capable of taking into account many features and perturbations. Real data from Mars Pathfinder mission is used. The goal is to be able to determine more accurately the atmosphere structure by observing real trajectories and what changes are to expect in probe descent trajectories if atmospheres have different properties than the ones assumed initially.

Author

*Descent Trajectories; Planetary Atmospheres; Mars Pathfinder; Perturbation*

**20070014643** San Jose State Univ., CA, USA

**A Search for Viable Venus and Jupiter Sample Return Mission Trajectories for the Next Decade**

Leong, Jason N.; Papadopoulos, Periklis; 2nd International Planetary Probe Workshop; April 2005, pp. 217-224; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

Planetary exploration using unmanned spacecraft capable of returning geologic or atmospheric samples have been discussed as a means of gathering scientific data for several years. Both NASA and ESA performed initial studies for Sample Return Missions (SRMs) in the late 1990 s, but most suggested a launch before the year 2010. The GENESIS and STARDUST spacecraft are the only current examples of the SRM concept with the Mars SRM expected around 2015. A feasibility study looking at SRM trajectories to Venus and Jupiter, for a spacecraft departing the Earth between the years 2011 through 2020 was conducted for a university project. The objective of the study was to evaluate SRMs to planets other than Mars, which has already gained significant attention in the scientific community. This paper is a synopsis of the study s mission trajectory concept and the conclusions to the viability of such a mission with today s technology.

Author

*Sample Return Missions; Jupiter (Planet); Venus (Planet); Stardust Mission; Mission Planning*

**20070014644** Ball Aerospace and Technologies Corp., USA

**Helium-3 Mining Aerostats in the Atmospheres of the Outer Planets**

VanCleve, Jeffrey E.; Grillmair, Carl; Hanna, Mark; Reinert, Rich; 2nd International Planetary Probe Workshop; April 2005; 14 pp.; In English; See also 20070014606; Copyright; Avail.: CASI: [A03](#), Hardcopy

Imagine an interplanetary future where: a) d-He3 fusion produces most of Earth s energy needs without radioactivity or carbon emissions; b) Space transportation has been revolutionized by an efficient fusion propulsion system with exhaust

velocity up to 0.088 c; c) Space commerce is stimulated by the existence of an interplanetary cargo worth \$3-M a kilogram; and d) Unmanned probes travel to the nearest star systems with flight times less than a human lifetime.

Derived from text

*Helium Isotopes; Planetary Atmospheres; Gas Giant Planets; Radioactivity*

**20070014645** NASA Ames Research Center, Moffett Field, CA, USA

### **Rotary-Wing Decelerators for Probe Descent Through the Atmosphere of Venus**

Young, Larry A.; Briggs, Geoffrey; Aiken, Edwin; Pisanich, Greg; 2nd International Planetary Probe Workshop; April 2005, pp. 209-215; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

An innovative concept is proposed for atmospheric entry probe deceleration, wherein one or more deployed rotors (in autorotation or wind-turbine flow states) on the aft end of the probe effect controlled descent. This concept is particularly oriented toward probes intended to land safely on the surface of Venus. Initial work on design trade studies is discussed.

Author

*Venus Atmosphere; Deceleration; Rotary Wings; Atmospheric Entry; Descent; Autorotation*

**20070014646** Lockheed Martin Space Systems Co., CA, USA

### **Genesis Sample Return Capsule Overview**

Willcockson, Bill; 2nd International Planetary Probe Workshop; April 2005; 7 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

I. Simple Entry Capsule Concept: a) Spin-Stabilized/No Active Control Systems; b) Ballistic Entry for 11.04 km/sec Velocity; c) No Heatshield Separation During Entry; d) Parachute Deploy via g-Switch + Timer. II. Stardust Design Inheritance a) Forebody Shape; b) Seal Concepts; c) Parachute Deploy Control; d) Utah Landing Site (UTTR). III. TPS Systems a) Heatshield - Carbon-Carbon - First Planetary Entry; b) Backshell - SLA-561V - Flight Heritage from Pathfinder, MER; d) Forebody Structural Penetrations Aerothermal and TPS Design Process has the Same Methodology as Used for Pathfinder, MER Flight Vehicles.

Derived from text

*Sample Return Missions; Atmospheric Entry; Heat Shielding; Timing Devices; Structural Design; Active Control*

**20070014647** Korea Advanced Inst. of Science and Technology, Daejeon, Korea, Republic of

### **On Nonequilibrium Radiation in Hydrogen Shock Layers**

Park, Chul; 2nd International Planetary Probe Workshop; April 2005, pp. 91-98; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The influence of thermochemical nonequilibrium in the shock layer over a vehicle entering the atmosphere of an outer planet is examined qualitatively. The state of understanding of the heating environment for the Galileo Probe vehicle is first reviewed. Next, the possible reasons for the high recession in the frustum region and the low recession in the stagnation region are examined. The state of understanding of the nonequilibrium in the hydrogen flow is then examined. For the entry flight in Neptune, the possible influence of nonequilibrium is predicted.

Author

*Hydrogen; Nonequilibrium Radiation; Shock Layers; Galileo Probe; Shock Tunnels*

**20070014648** Michigan Univ., Ann Arbor, MI, USA

### **Clouds of Neptune and Uranus**

Atreya, Sushil K.; Wong, Ah-San; 2nd International Planetary Probe Workshop; April 2005, pp. 107-110; In English; See also 20070014606; Copyright; Avail.: CASI: [A01](#), Hardcopy

We present results on the bases and concentrations of methane ice, ammonia ice, ammonium hydrosulfide-solid, water ice, and aqueous-ammonia solution (droplet) clouds of Neptune and Uranus, based on an equilibrium cloud condensation model. Due to their similar p-T structures, the model results for Neptune and Uranus are similar. Assuming 30-50x solar enhancement for the condensibles species, as expected from formation models, we find that the base of the droplet cloud is at the 370 bars for 30 solar, and at 500 bars for 50 solar cases. Despite this, entry probes need to be deployed to only 50-100 bars to obtain all the critical information needed to constrain models of the formation of these planets and their atmospheres.

Author

*Neptune (Planet); Uranus (Planet); Clouds (Meteorology); Atmospheric Models*

**20070014649** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands  
**ESA Venus Entry Probe Study**

vandenBerg, M. L.; Falkner, P.; Phipps, A.; Underwood, J. C.; Lingard, J. S.; Moorhouse, J.; Kraft, S.; Peacock, A.; 2nd International Planetary Probe Workshop; April 2005, pp. 201-207; In English; See also 20070014606; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The Venus Entry Probe is one of ESA's Technology Reference Studies (TRS). The purpose of the Technology Reference Studies is to provide a focus for the development of strategically important technologies that are of likely relevance for future scientific missions. The aim of the Venus Entry Probe TRS is to study approaches for low cost in-situ exploration of Venus and other planetary bodies with a significant atmosphere. In this paper, the mission objectives and an outline of the mission concept of the Venus Entry Probe TRS are presented.

Author

*Venus Probes; Mission Planning; Low Cost; In Situ Measurement*

**20070014650** NASA Ames Research Center, Moffett Field, CA, USA

**From H.G. Wells to Unmanned Planetary Exploration**

Boyd, John W.; 2nd International Planetary Probe Workshop; April 2005, pp. 337-342; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The possibility of planetary exploration has been a dream of the human race since Galileo discovered the moons of Jupiter in 1610. Visual sightings of bodies entering Earth's atmosphere have been made by Earth's inhabitants over the centuries. Over time, the many meteor showers (Leonid, Perseid) have provided dramatic evidence of the intense heat generated by a body entering Earth's atmosphere at hypervelocity speeds. More recently (in 1908), few viewed the Tunguska meteor that impacted in Siberia, but the destructive power on the countryside was awesome.

Derived from text

*Space Exploration; Earth Atmosphere; Galileo Spacecraft; Meteoroids; Jupiter Satellites*

**20070014651** Colorado Univ., Boulder, CO, USA

**Future Venus Probe Missions**

Esposito, Larry W.; 2nd International Planetary Probe Workshop; April 2005; 18 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Probes are essential to understanding Venus Direct implications for Earth's formation and history, origin of life, extra solar planets. Range of desired capability includes: a) Multiprobes; b) Descenders; c) Landers; d) Balloons; and e) Long-lived landers.

Author

*Space Missions; Venus Probes; Biological Evolution*

**20070014652** Centre National de la Recherche Scientifique, Paris, France

**Lavoisier: A Low Altitude Balloon Network for Probing the Deep Atmosphere and Surface of Venus**

Chassefiere, E.; Berthelier, J. J.; Bertaux, J.-L.; Quemerais, E.; Pommereau, J.-P.; Rannou, P.; Raulin, F.; Coll, P.; Coscia, D.; Jambon, A.; Sarda, P.; Sabroux, J. C.; Vitter, G.; LePichon, A.; Landeau, B.; Lognonne, P.; Cohen, Y.; Vergnole, S.; Hulot, G.; Manda, M.; Pineau, J.-F.; Bezard, B.; Keller, H U.; Titov, D.; Breuer, D.; 2nd International Planetary Probe Workshop; April 2005, pp. 189-200; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

The in-situ exploration of the low atmosphere and surface of Venus is clearly the next step of Venus exploration. Understanding the geochemistry of the low atmosphere, interacting with rocks, and the way the integrated Venus system evolved, under the combined effects of inner planet cooling and intense atmospheric greenhouse, is a major challenge of modern planetology. Due to the dense atmosphere (95 bars at the surface), balloon platforms offer an interesting means to transport and land in-situ measurement instruments. Due to the large Archimede force, a 2 cubic meter He-pressurized balloon floating at 10 km altitude may carry up to 60 kg of payload. LAVOISIER is a project submitted to ESA in 2000, in the follow up and spirit of the balloon deployed at cloud level by the Russian Vega mission in 1986. It is composed of a descent probe, for detailed noble gas and atmosphere composition analysis, and of a network of 3 balloons for geochemical and geophysical investigations at local, regional and global scales.

Author

*Venus Surface; Venus Probes; In Situ Measurement; Venus Atmosphere; Geochemistry; Planetology; Rocks; Greenhouse Effect; Balloon-Borne Instruments*

**20070014653** Vorticity Ltd., Oxfordshire, UK

**Revalidation of the Huygens Descent Control Sub-System**

2nd International Planetary Probe Workshop; April 2005, pp. 121-127; In English; See also 20070014606; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The Huygens probe, part of the Cassini mission to Saturn, is designed to investigate the atmosphere of Titan, Saturn's largest moon. The passage of the probe through the atmosphere is controlled by the Descent Control Sub-System (DCSS), which consists of three parachutes and associated mechanisms. The Cassini / Huygens mission was launched in October 1997 and was designed during the early 1990's. During the time since the design and launch, analysis capabilities have improved significantly, knowledge of the Titan environment has improved and the baseline mission has been modified. Consequently, a study was performed to revalidate the DCSS design against the current predictions.

Author

*Cassini Mission; Huygens Probe; Parachute Descent; Spacecraft Design*

**20070014654** EADS Space Transportation, Lampoldshausen, Germany

**Thermal Protection of the Huygens Probe During Titan Entry: Last Questions**

Bouilly, Jean-Marc; 2nd International Planetary Probe Workshop; April 2005, pp. 113-120; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

CASSINI-HUYGENS mission is a cooperation between NASA and ESA, dedicated to the exploration of the Saturnian system. In the framework of this mission, the entry of the HUYGENS probe in the atmosphere of TITAN will be of major scientific interest. One of the essential points of the HUYGENS mission is therefore the good behavior of the thermal shield designed to maintain the aerodynamic shape and to protect the probe from excessive heating during the atmospheric entry on TITAN. The design and the qualification of this thermal shield were carried out between 1992 and 1995 (development phase). Currently, the final definition of mission parameters is being completed. As the performance of the thermal shield is one of all the parameters considered at system level, it is therefore necessary to reassess the thermal response of the TPS, taking into account some updated information that was not yet available during the development phase. After some recall of the results of 1992 to 1995, the paper will present a status of the current work on TPS.

Author

*Atmospheric Entry; Huygens Probe; Thermal Protection; Titan; Cassini Mission*

**20070014655** Padua Univ., Italy

**The Huygens Atmospheric Structure Instrument (HASI): Expected Results at Titan and Performance Verification in Terrestrial Atmosphere**

Ferri, F.; Fulchignoni, M.; Colombatti, G.; Stoppato, P. F. Lion; Zarnecki, J. C.; Harri, A. M.; Schwingenschuh, K.; Hamelin, M.; Flamini, E.; Bianchini, G.; Angrilli, F.; 2nd International Planetary Probe Workshop; April 2005, pp. 129-135; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The Huygens ASI is a multi-sensor package resulting from an international cooperation, it has been designed to measure the physical quantities characterizing Titan's atmosphere during the Huygens probe mission. On 14th January, 2005, HASI will measure acceleration, pressure, temperature and electrical properties all along the Huygens probe descent on Titan in order to study Titan's atmospheric structure, dynamics and electric properties. Monitoring axial and normal accelerations and providing direct pressure and temperature measurements during the descent, HASI will mainly contribute to the Huygens probe entry and trajectory reconstruction. In order to simulate the Huygens probe descent and verify HASI sensors performance in terrestrial environment, stratospheric balloon flight experiment campaigns have been performed, in collaboration with the Italian Space Agency (ASI). The results of flight experiments have allowed to determine the atmospheric vertical profiles and to obtain a set of data for the analysis of probe trajectory and attitude reconstruction.

Author

*Huygens Probe; Titan Atmosphere; Instrument Packages; Sensors; Flight Tests*

**20070014656** Lockheed Martin Technical Operations, Inc., Sunnyvale, CA, USA

**New Approach for Thermal Protection System of a Probe During Entry**

Yendler, Boris; Poffenbarger, Nathan; Patel, Amisha; Bhave, Ninad; Papadopoulos, Periklis; 2nd International Planetary Probe Workshop; April 2005, pp. 245-250; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

One of the biggest challenges for any thermal protection system (TPS) of a probe is to provide a sufficient barrier for heat



generated during descent in order to keep the temperature inside of the probe low enough to support operational temperature of equipment. Typically, such a goal is achieved by having the ceramic tiles and blankets like on the Space Shuttle, silicon based ablators, or metallic systems to cover the probe external surface. This paper discusses the development of an innovative technique for TPS of the probe. It is proposed to use a novel TPS which comprises thermal management of the entry vehicle. It includes: a) absorption of the heat during heat pick load by a Phase Change Material (PCM), b) separation of the compartment which contains PCM from the rest of the space vehicle by a gap with a high thermal resistance, c) maintaining temperature of the internal wall of s/c cabin temperature by transfer heat from the internal wall to the 'cold' side of the vehicle and to reject heat into the space during the flight and on a ground, d) utilization of an advanced heat pipe, so called Loop Heat Pipe to transfer heat from the cabin internal wall to the cold side of the s/c and to reject the heat into environment outside of the vehicle. A Loop Heat Pipe is capable of transferring heat against gravity

Author

*Thermal Protection; Temperature Control; Space Probes; Ceramics; Ablative Materials; Descent; Thermal Resistance; Wall Temperature*

**20070014657** Ball Aerospace and Technologies Corp., Boulder, CO, USA

#### **Ultralightweight Ballute Technology Advances**

Masciarelli, Jim; Miller, Kevin; 2nd International Planetary Probe Workshop; April 2005, pp. 239-243; In English; See also 20070014606; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAS8-02130; Copyright; Avail.: CASI: [A01](#), Hardcopy

Ultralightweight ballutes offer the potential to provide the deceleration for entry and aerocapture missions at a fraction of the mass of traditional methods. A team consisting of Ball Aerospace, ILC Dover, NASA Langley, NASA Johnson, and the Jet Propulsion Laboratory has been addressing the technical issues associated with ultralightweight ballutes for aerocapture at Titan. Significant progress has been made in the areas of ballute materials, aerothermal analysis, trajectory control, and aeroelastic modeling. The status and results of efforts in these areas are presented. The results indicate that an ultralightweight ballute system mass of 8 to 10 percent of the total entry mass is possible.

Author

*Ballutes; Deceleration; Aerothermodynamics; Trajectory Control; Aeroelasticity*

**20070014658** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

#### **Entry, Descent and Landing Using Ballutes**

Lyons, Daniel t.; McRonald, Angus; 2nd International Planetary Probe Workshop; April 2005; 12 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

The In Space Propulsion Program is funding a team lead by Kevin Miller at Ball Aerospace. This team of Industry, NASA, and Academic researchers is actively pursuing ballute technology development, with very promising results. The focus of that study has been to maximize the payload that is put into orbit (around Titan, Neptune, and Mars). So far the mass associated with the ballute has been minimized, because it was being thrown away. If an instrument package is attached to the Ballute, it will eventually land on the surface. Thus, the Ballute can do double duty: Aerocapture the Orbiter and Soft-land a set of instruments on the surface.

Author

*Ballutes; Space Programs; Aerocapture; Descent; Payloads; Instrument Packages*

**20070014659** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

#### **Overview of the Phoenix Entry, Descent and Landing System**

Grover, Rob; 2nd International Planetary Probe Workshop; April 2005; 12 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on the entry, descent and landing system of Phoenix is shown. The topics include: 1) Phoenix Mission Goals; 2) Payload; 3) Aeroshell/Entry Comparison; 4) Entry Trajectory Comparison; 5) Phoenix EDL Timeline; 6) Hypersonic Phase; 7) Parachute Phase; 8) Terminal Descent Phase; and 9) EDL Communications.

CASI

*Descent; Phoenix Sounding Rocket; General Overviews; Landing Aids; Atmospheric Entry*

**20070014660** Arizona Univ., AZ, USA

#### **Parachute Dynamics Investigations Using a Sensor Package Airdropped from a Small-Scale Airplane**

Dooley, Jessica; Lorenz, Ralph D.; 2nd International Planetary Probe Workshop; April 2005, pp. 163-170; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

We explore the utility of various sensors by recovering parachute-probe dynamics information from a package released from a small-scale, remote-controlled airplane. The airdrops aid in the development of datasets for the exploration of planetary probe trajectory recovery algorithms, supplementing data collected from instrumented, full-scale tests and computer models.

Author

*Airdrops; Parachutes; Remote Control; Trajectories*

**20070014661** Academy of Sciences, Graz, Austria

**Simulation Results of the Huygens Probe Entry and Descent Trajectory Reconstruction Algorithm**

Kazeminejad, B.; Atkinson, D. H.; Perez-Ayucar, M.; 2nd International Planetary Probe Workshop; April 2005, pp. 171-179; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

Cassini/Huygens is a joint NASA/ESA mission to explore the Saturnian system. The ESA Huygens probe is scheduled to be released from the Cassini spacecraft on December 25, 2004, enter the atmosphere of Titan in January, 2005, and descend to Titan's surface using a sequence of different parachutes. To correctly interpret and correlate results from the probe science experiments and to provide a reference set of data for 'ground-truthing' Orbiter remote sensing measurements, it is essential that the probe entry and descent trajectory reconstruction be performed as early as possible in the postflight data analysis phase. The Huygens Descent Trajectory Working Group (DTWG), a subgroup of the Huygens Science Working Team (HSWT), is responsible for developing a methodology and performing the entry and descent trajectory reconstruction. This paper provides an outline of the trajectory reconstruction methodology, preliminary probe trajectory retrieval test results using a simulated synthetic Huygens dataset developed by the Huygens Project Scientist Team at ESA/ESTEC, and a discussion of strategies for recovery from possible instrument failure.

Author

*Huygens Probe; Cassini Mission; European Space Agency; Saturn (Planet); Descent Trajectories; Remote Sensing*

**20070014662** NASA Ames Research Center, Moffett Field, CA, USA

**Development of Solid State Thermal Sensors for Aeroshell TPS Flight Applications**

Martinez, Ed; Oishi, Tomo; Gorbonov, Sergey; 2nd International Planetary Probe Workshop; April 2005, pp. 235-238; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

In-situ Thermal Protection System (TPS) sensors are required to provide verification by traceability of TPS performance and sizing tools. Traceability will lead to higher fidelity design tools, which in turn will lead to lower design safety margins, and decreased heatshield mass. Decreasing TPS mass will enable certain missions that are not otherwise feasible, and directly increase science payload. NASA Ames is currently developing two flight measurements as essential to advancing the state of TPS traceability for material modeling and aerothermal simulation: heat flux and surface recession (for ablators). The heat flux gage is applicable to both ablators and non-ablators and is therefore the more generalized sensor concept of the two with wider applicability to mission scenarios. This paper describes the continuing development of a thermal microsensor capable of surface and in-depth temperature and heat flux measurements for TPS materials appropriate to Titan, Neptune, and Mars aerocapture, and direct entry. The thermal sensor is a monolithic solid state device composed of thick film platinum RTD on an alumina substrate. Choice of materials and critical dimensions are used to tailor gage response, determined during calibration activities, to specific (forebody vs. aftbody) heating environments. Current design has maximum operating temperature of 1500K, and allowable constant heat flux of  $q=28.7 \text{ W/cm}^2$ , and time constants between 0.05 and 0.2 seconds. The catalytic and radiative response of these heat flux gages can also be changed through the use of appropriate coatings. By using several co-located gages with various surface coatings, data can be obtained to isolate surface heat flux components due to radiation, catalytic and convection. Selectivity to radiative heat flux is a useful feature even for an in-depth gage, as radiative transport may be a significant heat transport mechanism for porous TPS materials in Titan aerocapture.

Derived from text

*Sensors; Solid State Devices; Thermal Protection; In Situ Measurement; Aeroshells*

**20070014663** NASA Ames Research Center, Moffett Field, CA, USA

**Nanostructured Thermal Protection Systems for Space Exploration Missions**

Arnold, J. O.; Chen, Y. K.; Squire, T.; Srivastava, D.; Allen, G., Jr.; Stackpoole, M.; Goldstein, H. E.; Venkatapathy, E.; Loomis, M. P.; 2nd International Planetary Probe Workshop; April 2005, pp. 301-311; In English; See also 20070014606; Original contains color illustrations

Contract(s)/Grant(s): NAS2-3144; NAG2-1580; Copyright; Avail.: CASI: [A03](#), Hardcopy

Strong research and development programs in nanotechnology and Thermal Protection Systems (TPS) exist at NASA Ames. Conceptual studies have been undertaken to determine if new, nanostructured materials (composites of existing TPS materials and nanostructured composite fibers) could improve the performance of TPS. To this end, we have studied various candidate heatshields, some composed of existing TPS materials (with known material properties), to provide a baseline for comparison with others that are admixtures of such materials and a nanostructured material. In the latter case, some assumptions were made about the thermal conductivity and strength of the admixture, relative to the baseline TPS material. For the purposes of this study, we have made the conservative assumption that only a small fraction of the remarkable properties of carbon nanotubes (for example) will be realized in the material properties of the admixtures employing them. The heatshields studied included those for Sharp leading edges (appropriate to out-of-orbit entry and aero-maneuvering), probes, an out-of-orbit Apollo Command Module (as a surrogate for NASA's new Crew Exploration Vehicle [CEV]), a Mars Sample Return Vehicle and a large heat shield for Mars aerocapture missions. We report on these conceptual studies, which show that in some cases (not all), significant improvements in the TPS can be achieved through the use of nanostructured materials.

Author

*Nanotechnology; Space Exploration; Thermal Protection; Space Missions; Carbon Nanotubes*

**20070014664** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **In-Space Propulsion (ISP) Aerocapture Technology**

Munk, Michelle M.; James, Bonnie F.; Moon, Steve; 2nd International Planetary Probe Workshop; April 2005; 20 pp.; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation is shown to raise awareness of aerocapture technology through in-space propulsion. The topics include: 1) Purpose; 2) In-Space Propulsion Program; 3) Aerocapture Overview; 4) Aerocapture Technology Alternatives; 5) Aerocapture Technology Project Process; 6) Results from 2002 Aerocapture TAG; 7) Bounding Case Requirements; 8) ST9 Flight Demonstration Opportunity; 9) Aerocapture NRA Content: Cycles 1 and 2; 10) Ames Research Center TPS Development; 11) Applied Research Associates TPS Development; 12) LaRC Structures Development; 13) Lockheed Martin Astronautics Aeroshell Development; 14) ELORET/ARC Sensor Development; 15) Ball Aerospace Trailing Ballute Development; 16) Cycle 2 NRA Selections - Aerocapture; and 17) Summary.

CASI

*Aerocapture; Technology Utilization; Spacecraft Propulsion; Astronautics*

**20070014665** Boston Univ., Boston, MA, USA

### **Should We Believe Atmospheric Temperatures Measured by Entry Accelerometers Traveling at 'Slow' Near-Sonic Speeds?**

Withers, Paul; 2nd International Planetary Probe Workshop; April 2005, pp. 13-19; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

Mars Pathfinder's Accelerometer instrument measured an unexpected and large temperature inversion between 10 and 20 kilometer altitude. Other instruments have failed to detect similar temperature inversions. I test whether this inversion is real or not by examining what changes have to be made to the assumptions in the accelerometer data processing to obtain a more 'expected' temperature profile. Changes in derived temperature of up to 30K, or 15%, are necessary, which correspond to changes in derived density of up to 25% and changes in derived pressure of up to 10%. If the drag coefficient is changed to satisfy this, then instead of decreasing from 1.6 to 1.4 from 20 kilometers to 10 kilometers, the drag coefficient must increase from 1.6 to 1.8 instead. If winds are invoked, then speeds of 60 meters per second are necessary, four times greater than those predicted. Refinements to the equation of hydrostatic equilibrium modify the temperature profile by an order of magnitude less than the desired amount. Unrealistically large instrument drifts of 0.5-1.0 meters per square second are needed to adjust the temperature profile as desired. However, rotational contributions to the accelerations may have the necessary magnitude and direction to make this correction. Determining whether this hypothesis is true will require further study of the rigid body equations of motion, with detailed knowledge of the positions of all six accelerometers. The paradox concerning this inversion is not yet resolved. It is important to resolve it because the paradox has some startling implications. At one extreme, are temperature profiles derived from accelerometers inherently inaccurate by 20K or more? At the other extreme, are RS temperature profiles inaccurate by this same amount?

Author

*Accelerometers; Atmospheric Temperature; Atmospheric Entry; Mars Pathfinder*

**20070014666** Bay Area Environmental Research Ins., Moffett Field, CA, USA

**The Next Generation of Planetary Atmospheric Probes**

Houben, Howard; 2nd International Planetary Probe Workshop; April 2005, pp. 21-26; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

Entry probes provide useful insights into the structures of planetary atmospheres, but give only one-dimensional pictures of complex four-dimensional systems that vary on all temporal and spatial scales. This makes the interpretation of the results quite challenging, especially as regards atmospheric dynamics. Here is a planetary meteorologist's vision of what the next generation of atmospheric entry probe missions should be: Dedicated sounding instruments get most of the required data from orbit. Relatively simple and inexpensive entry probes are released from the orbiter, with low entry velocities, to establish ground truth, to clarify the vertical structure, and for adaptive observations to enhance the dataset in preparation for sensitive operations. The data are assimilated onboard in real time. The products, being immediately available, are of immense benefit for scientific and operational purposes (aerobraking, aerocapture, accurate payload delivery via glider, ballooning missions, weather forecasts, etc.).

Author

*Planetary Atmospheres; Space Probes; Atmospheric Entry; Atmospheric Sounding; Space Missions*

**20070014667** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Benefits of Application of Advanced Technologies for a Neptune Orbiter, Atmospheric Probes and Triton Lander**

Somers, Alan; Celano, Luigi; Kauffman, Jeffrey; Rogers, Laura; Peterson, Craig; 2nd International Planetary Probe Workshop; April 2005, pp. 81-89; In English; See also 20070014606; Copyright; Avail.: CASI: [A02](#), Hardcopy

Missions with planned launch dates several years from today pose significant design challenges in properly accounting for technology advances that may occur in the time leading up to actual spacecraft design, build, test and launch. Conceptual mission and spacecraft designs that rely solely on off the shelf technology will result in conservative estimates that may not be attractive or truly representative of the mission as it actually will be designed and built. This past summer, as part of one of NASA's Vision Mission Studies, a group of students at the Laboratory for Spacecraft and Mission Design (LSMD) have developed and analyzed different Neptune mission baselines, and determined the benefits of various assumed technology improvements. The baseline mission uses either a chemical propulsion system or a solar-electric system. Insertion into orbit around Neptune is achieved by means of aerocapture. Neptune's large moon Triton is used as a tour engine. With these technologies a comprehensive Cassini-class investigation of the Neptune system is possible. Technologies under investigation include the aerocapture heat shield and thermal protection system, both chemical and solar electric propulsion systems, spacecraft power, and energy storage systems.

Author

*Neptune (Planet); Technology Utilization; Aerocapture; Atmospheric Sounding; Environmental Monitoring; Triton; Spacecraft Landing; Planetary Orbits*

**20070014668** Padua Univ., Italy

**Attitude Issues on the Huygens Probe: Balloon Dropped Mock up Role in Determining Reconstruction Strategies During Descent in Lower Atmosphere**

Bettanini, C.; Angrilli, F.; 2nd International Planetary Probe Workshop; April 2005, pp. 147-152; In English; See also 20070014606; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

As part of the collaboration with Italian Space Agency on HASI instrument for Huygens mission, University of Padova has been conducting since 2001 scientific activity on Stratospheric Balloon Launches from the Trapani base in Sicily. The most recent boomerang flight in July 2003 has successfully flown a mock up of the Huygens probe hosting spares of flight scientific units and extra housekeeping and scientific sensors on a parachuted descent from 33 kilometre altitude. This work presents the studies conducted on attitude reconstruction of the probe, as well as the utilisation of iterative extended Kalman filtering in investigating vanes induced spin rate and in providing a baseline for the performance evaluation of Huygens accelerometers operations. Finally some possible contributions on the reconstruction of the lower part of Titan descent for Huygens probe are suggested based on the confrontation of sensor data for 2003 flight.

Author

*Parachute Descent; Huygens Probe; Lower Atmosphere; Attitude (Inclination); Balloon Flight; Instrument Packages*

**20070014669** NASA Ames Research Center, Moffett Field, CA, USA

**A Model Based Mars Climate Database for the Mission Design**

2nd International Planetary Probe Workshop; April 2005; 16 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on a model based climate database is shown. The topics include: 1) Why a model based climate database?; 2) Mars Climate Database v3.1 Who uses it ? (approx. 60 users!); 3) The new Mars Climate database MCD v4.0; 4) MCD v4.0: what's new ? 5) Simulation of Water ice clouds; 6) Simulation of Water ice cycle; 7) A new tool for surface pressure prediction; 8) Access to the database MCD 4.0; 9) How to access the database; and 10) New web access  
CASI

*Climate; Data Bases; Space Missions; Mars Environment; Models; Design Analysis*

**20070014670** Padua Univ., Italy

**Atmospheric Stability & Turbulence from Temperature Profiles over Sicily During Summer 2002 & 2003 HASI Balloon Campaigns**

Colombatti, G.; Ferri, F.; Angrilli, F.; Fulchignoni, M.; 2nd International Planetary Probe Workshop; April 2005, pp. 153-161; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

Experimental results and interpretation of the temperature measurements data retrieved during the balloon campaigns (in 2002 and in 2003) for testing HASI (Huygens Atmospheric Structure Instrument), launched from the Italian Space Agency Base in Trapani (Sicily), are presented. Both ascending and descending phases are analysed; data reveal interesting features near the tropopause (present in the region between 11km-14km), where temperature cooling can be related to layers with strong winds (2002 flight); in the troposphere a multistratified structure of the temperature field is observed and discussed (particularly in the 2003 flight) Finally, stability and turbulence of the atmosphere are analysed; the buoyancy N2 parameters for both the flights show lower value respect to standard tropospheric values corresponding to a lower stability of the atmosphere; still there is a higher stability above the tropopause. The energy spectrum of temperature data is consistent with the Kolmogorov theory: the characteristic  $k^{(sup -5/3)}$  behaviour is reproduced.

Author

*Sicily; Summer; Temperature Profiles; Huygens Probe; Instrument Packages; Turbulence; Balloon Flight; Stability*

**20070014671** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**A Surface Science Paradigm for a Post-Huygens Titan Mission**

Zimmerman, Wayne F.; Lunine, Jonathan; Lorenz, Ralph; 2nd International Planetary Probe Workshop; April 2005, pp. 137-146; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

With the Cassini-Huygens atmospheric probe drop-off mission fast approaching, it is essential that scientists and engineers start scoping potential follow-on surface science missions. This paper provides a summary of the first year of a two year design study which examines in detail the desired surface science measurements and resolution, potential instrument suite, and complete payload delivery system. Also provided are design concepts for both an aerial inflatable mobility platform and deployable instrument sonde. The tethered deployable sonde provides the capability to sample near surface atmosphere, sub-surface liquid (if it exists), and surface solid material. Actual laboratory tests of the amphibious sonde prototype are also presented.

Author

*Cassini Mission; Huygens Probe; Titan; Planetary Surfaces; Mariner Mark 2 Spacecraft; Aerospace Sciences; Spaceborne Experiments*

**20070014672** NASA, USA

**NASA's Solar System Exploration Program**

Robinson, James; 2nd International Planetary Probe Workshop; April 2005; 41 pp.; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation describing NASA's Solar System Exploration Program is shown. The topics include: 1) Solar System Exploration with Highlights and Status of Programs; 2) Technology Drivers and Plans; and 3) Summary

CASI

*Solar System; Space Exploration; NASA Space Programs; Space Missions*



**20070014673** European Space Agency, France

**Planetary Exploration in ESA**

Schwehm, Gerhard H.; 2nd International Planetary Probe Workshop; April 2005; 31 pp.; In English; See also 20070014606; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on planetary exploration in the European Space Agency is shown. The topics include: 1) History of the Solar System Material; 2) ROSETTA: The Comet Mission; 3) A New Name For The Lander: PHILAE; 4) The Rosetta Mission; 5) Lander: Design Characteristics; 6) SMART-1 Mission; 7) MARS Express VENUS Express; 8) Planetary Exploration in ESA The Future.

CASI

*European Space Agency; Space Exploration; Solar System; Space Missions*

**20070014674** NASA Langley Research Center, Hampton, VA, USA

**MSL Entry, Descent and Landing Performance and Environments**

Lockwood, Mary Kae; Dwyer-Cianciola, Alicia; Dyakonov, Artem; Edquist, Karl; Powell, Dick; Striepe, Scott; Way, David; Graves, Claude; Carman, Gil; Sostaric, Ron; 2nd International Planetary Probe Workshop; April 2005; 19 pp.; In English; See also 20070014606; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation on the MARS Science Laboratory (MSL) Entry, Descent and Landing (EDL) performance and environments is shown. The topics include: 1) High Altitude and Precision Landing; 2) Guided, Lifting, Ballistic Trade; 3) Supersonic Chute Deploy Altitude; 4) Guided, Lifting, Ballistic Landing Footprint Video; 5) Transition Indicator at Peak Heating Point on Trajectory; 6) Aeroheating at Peak Heating Point on Trajectory Nominal, No Uncertainty Included; 7) Comparison to Previous Missions; 8) Pork Chop Plots - EDL Performance for Mission Design; 9) Max Heat Rate Est (CBE+Uncert) W/cm<sup>2</sup>; 10) Nominal Super Chute Deploy Alt Above MOLA (km); 11) Monte Carlo; 12) MSL Option M2 Entry, Descent and Landing; 13) Entry Performance; 14) Entry Aeroheating and Entry g's; 15) Terminal Descent; and 16) How An Ideal Chute Deployment Altitude Varies with Time of Year and Latitude (JSC Chart).

CASI

*Descent; Mars Landing; Entry; Mars Environment; Spacecraft Performance*

**20070014675** California Inst. of Tech., Pasadena, CA, USA

**Basic Questions About the Solar System: The Need for Probes**

Ingersoll, Andrew P.; 2nd International Planetary Probe Workshop; April 2005; 4 pp.; In English; See also 20070014606; Copyright; Avail.: CASI: [A01](#), Hardcopy

Probes are an essential element in the scientific study of planets with atmospheres. In-situ measurements provide the most accurate determination of composition, winds, temperatures, clouds, and radiative fluxes. They address fundamental NASA objectives concerning volatile compounds, climate, and the origin of life. Probes also deliver landers and aerobots that help in the study of planetary surfaces. This talk focuses on Venus, Titan, and the giant planets. I review the basic science questions and discuss the recommended missions. I stress the need for a balanced program that includes an array of missions that increase in size by factors of two. Gaps in this array lead to failures and cancellations that are harmful to the program and to scientific exploration.

Author

*Space Probes; Solar System; Space Missions; Gas Giant Planets; Titan; Venus (Planet)*

**20070014676** Boeing Satellite Systems, Inc., Los Angeles, CA, USA

**Lessons From the Pioneer Venus Program**

Dorfman, Steven D.; 2nd International Planetary Probe Workshop; April 2005, pp. 343-345; In English; See also 20070014606; Copyright; Avail.: CASI: [A01](#), Hardcopy

We began the Pioneer Venus contract in late 1974 with a planned launch of the Orbiter in May 1978 and the Multiprobe in August 1978. Because we had four years, we thought there was plenty of time. As it turned out, we barely made the launch dates. The Orbiter was relatively straightforward, compared to the Multiprobe Bus and Probes that had to survive descent through the harsh Venusian atmosphere. To help overcome our many Multiprobe problems we formed a strong global team. The GE reentry team in Philadelphia, experienced in designing vehicles to enter the earth's atmosphere, was assigned the responsibility for the Probe entry system, including protective heat shielding and parachute design to extract the scienceladen Large Probe pressure vessel and control its descent through the Venusian clouds. Since the Probes had to remain stable as they descended through the Venus atmosphere, we used the aerodynamic expertise at the Hughes Missile Division, NASA's Ames

Research Center and the Langley Research Center. Since the pressure at the surface of Venus was equivalent to an ocean depth of 3300 feet, we went to the Navy's David Taylor Research Center for their deepsea expertise. To test the pressure vessel at the high pressure and temperatures anticipated at Venus we went to the only facility capable of simulating the Venus surface environment, the Southwest Research Institute in San Antonio, Texas. We had dozens of subcontractors all over the world. As we developed our design, we began an extensive program to validate the ability of our Probe hardware to withstand the Venus environment. During this testing, we encountered numerous problems, mostly associated with adapting earth-based hardware to operate in the anticipated Venus environment. For example, the Large Probe pressure vessel imploded with a very loud bang the first time we tested its ability to withstand the high pressure and temperature on the Venusian surface. We had to go back and redesign, increasing the pressure vessel wall thickness. In addition, during the first tests of the parachute system, our parachute system ripped apart and had to be redesigned. Finally, at the aptly named test range in Truth or Consequences, New Mexico, we successfully demonstrated the parachute design by drop

Author

*Pioneer Venus Spacecraft; Venus Surface; Venus (Planet); Venus Clouds; Pressure Vessels*

## 89

### ASTRONOMY

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

**20070013786** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **The Prospects for X-ray Polarimetry and its Potential use for Understanding Neutron Stars**

Weisskopf, M. C.; Elsner, R. F.; Hanna, D.; Kaspi, V. M.; O'Dell, S. L.; Pavlov, G. G.; Ramsey, B. D.; [2007]; 16 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

We review the state of the art for measuring the X-ray polarization of neutron stars. We discuss how valuable precision measurements of the degree and position angle of polarization as a function of energy and, where relevant, of pulse phase, would provide deeper insight into the details of the emission mechanisms. We then review the current state of instrumentation and its potential for obtaining relevant data. Finally, we conclude our discussion with some opinions as to future directions.

Author

*Neutron Stars; Polarimetry; X Rays*

**20070013887** National Space Science and Technology Center, Huntsville, AL, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Monitoring Accreting X-ray Pulsars with the GLAST Burst Monitor**

Wilson, Colleen A.; Finger, Mark H.; Patel, Sandeep K.; Bhat, P. Narayana; Preece, Robert D.; Meegan, Charles A.; February 8, 2007; 9 pp.; In English; First GLAST Symposium, 5-8 Feb. 2007, Palo Alto, CA, USA; Copyright; Avail.: CASI: [A02](#), Hardcopy

Accreting pulsars are exceptionally good laboratories for probing the detailed physics of accretion onto magnetic stars. While similar accretion flows also occur in other types of astrophysical systems, e.g. magnetic CVs, only neutron stars have a small enough moment of inertia for the accretion of angular momentum to result in measurable changes in spin-frequency in a timescale of days. Long-term monitoring of accreting pulsar spin-frequencies and fluxes was demonstrated with the Burst and Transient Source Experiment (BATSE) on the Compton Gamma Ray Observatory. Here we present sample results from BATSE, discuss measurement techniques appropriate for GBM, and estimate the expected GBM sensitivity.

Author

*Pulsars; X Ray Astronomy; Accretion Disks; Gamma Ray Bursts; Monitors*

**20070013996** California Univ., San Diego, La Jolla, CA, USA

#### **Identifications of Four Integral Sources in the Galactic Plane via CHANDRA Localizations**

Tomsick, John A.; Chaty, Sylvain; Rodriguez, Jerome; Foschini, Luigi; Walter, Roland; Kaaret, Philip; The Astrophysical Journal; August 20, 2006; Volume 647, Part 1, pp. 1309-1322; In English

Contract(s)/Grant(s): NAS8-03060; I/R/046/04; COFIN 2004-023189; NNG05GC49G; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1086/505595>

Hard X-ray imaging of the Galactic plane by the INTEGRAL satellite is uncovering large numbers of 20-100 keV 'IGR' sources. We present results from Chandra, INTEGRAL, optical, and IR observations of four IGR sources: three sources in the

Norma region of the Galaxy (IGR J16195-4945, IGR J16207-5129, and IGR J16167-4957) and one that is closer to the Galactic center (IGR 5171 95-4100). In all four cases, one relatively bright Chandra source is seen in the INTEGRAL error circle, and these are likely to be the soft X-ray counterparts of the IGR sources. They have hard 0.3-10 keV spectra with power-law photon indices of  $\Gamma = 0.5-1.1$ . While many previously studied IGR sources show high column densities (NH approx.  $10^{23}$ - $10^{24}$ /sq cm), only IGR J16195-4945 has a column density that could be as high as  $10^{23}$ /sq cm. Using optical and IR sky survey catalogs and our own photometry, we have obtained identifications for all four sources. The J-band magnitudes are in the range 14.9-10.4, and we have used the optical/IR spectral energy distributions (SEDs) to constrain the nature of the sources. Blackbody components with temperature lower limits of 9400 K for IGR J16195-4945 and 18,000 K for IGR J16207-5129 indicate that these are very likely high-mass X-ray binaries (HMXBs). However, for IGR 516167-4957 and IGR J17195-4100, low extinction and the SEDs indicate later spectral types for the putative companions, suggesting that these are not HMXBs.

Author

*X Ray Imagery; Spectral Counterparts (Astronomy); Spectral Energy Distribution; Infrared Astronomy; Sky Surveys (Astronomy); Photometry*

## 90 ASTROPHYSICS

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

**20070013961** Stanford Linear Accelerator Center, Stanford, CA, USA

### **Numerical Simulations of the Metallicity Distribution in Dwarf Spheroidal Galaxies**

Ripamonti, E.; Tolstoy, E.; Helmi, A.; Battaglia, G.; Abel, T.; Dec. 01, 2006; 6 pp.; In English

Report No.(s): DE2006-896421; SLAC-PUB-12260; No Copyright; Avail.: National Technical Information Service (NTIS)

Recent observations show that the number of stars with very low metallicities in the dwarf spheroidal satellites of the Milky Way is low, despite the low average metallicities of stars in these systems. We undertake numerical simulations of star formation and metal enrichment of dwarf galaxies in order to verify whether this result can be reproduced with 'standard' assumptions. The answer is likely to be negative, unless some selection bias against very low metallicity stars is present in the observations.

NTIS

*Dwarf Galaxies; Galaxies; Metallicity; Astrophysics*

**20070014677** Lawrence Livermore National Lab., Livermore, CA USA

### **Search for Small Trans-Neptunian Objects by the TAOS Project**

Chen, W. P.; Alcock, C.; Axelrod, T.; Bianco, F. B.; Byun, Y. I.; Nov. 09, 2006; 6 pp.; In English

Report No.(s): DE2006-896613; UCRL-PROC-225991; No Copyright; Avail.: National Technical Information Service (NTIS)

The Taiwan-America Occultation Survey (TAOS) aims to determine the number of small icy bodies in the outer reach of the Solar System by means of stellar occultation. An array of 4 robotic small ( $D=0.5$ m), wide-field ( $f/1.9$ ) telescopes have been installed at Lulin Observatory in Taiwan to simultaneously monitor some thousand of stars for such rare occultation events. Because a typical occultation event by a TNO a few km across will last for only a fraction of a second, fast photometry is necessary. A special CCD readout scheme has been devised to allow for stellar photometry taken a few times per second. Effective analysis pipelines have been developed to process stellar light curves and to correlate any possible flux changes among all telescopes. A few billion photometric measurements have been collected since the routine survey began in early 2005. Our preliminary result of a very low detection rate suggests a deficit of small TNOs down to a few km size, consistent with the extrapolation of some recent studies of larger (30-100 km) TNOs.

NTIS

*Ice; Solar System; Stellar Occultation; Surveys; Taiwan; Trans-Neptunian Objects*

## 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*.

**20070013778** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Preliminary Evaluation of Convective Heat Transfer in a Water Shield for a Surface Power Reactor**

Pearson J. Boise; Reid, Robert S.; [2007]; 2 pp.; In English; American Nuclear Society Winter Meeting and Nuclear Technology Expo, 12-16 Nov. 2006, Albuquerque, NM, USA; Copyright; Avail.: CASI: [A01](#), Hardcopy

As part of the Vision for Space Exploration, the end of the next decade will bring man back to the surface of the moon. A crucial issue for the establishment of human presence on the moon will be the availability of compact power sources. This presence could require greater than 10's of kWt's in follow on years. Nuclear reactors are well suited to meet the needs for power generation on the lunar or Martian surface. Radiation shielding is a key component of any surface power reactor system. Several competing concepts exist for lightweight, safe, robust shielding systems such as a water shield, lithium hydride (LiH), and boron carbide. Water offers several potential advantages, including reduced cost, reduced technical risk, and reduced mass. Water has not typically been considered for space reactor applications because of the need for gravity to fix the location of any vapor that could form radiation streaming paths. The water shield concept relies on the predictions of passive circulation of the shield water by natural convection to adequately cool the shield. This prediction needs to be experimentally evaluated, especially for shields with complex geometries. NASA Marshall Space Flight Center has developed the experience and facilities necessary to do this evaluation in its Early Flight Fission - Test Facility (EFF-TF).

Author

*Convective Heat Transfer; Power Reactors; Space Exploration; Test Facilities; Radiation Shielding; Water Circulation*

**20070013812** Stanford Linear Accelerator Center, CA, USA

### **GLAST Status and Application to Microquasars**

Dubois, R.; Nov. 2006; 5 pp.; In English

Report No.(s): DE2006-895265; SLAC-PUB-12174; No Copyright; Avail.: National Technical Information Service (NTIS)

The Gamma-ray Large Area Space Telescope (GLAST) is a next generation high energy gamma-ray observatory due for launch in Fall 2007. The primary instrument is the Large Area Telescope (LAT), which will measure gamma-ray flux and spectra from 20 MeV to  $\gtrsim$  300 GeV and is a successor to the highly successful EGRET experiment on CGRO. The LAT will have better angular resolution, greater effective area, wider field of view and broader energy coverage than any previous experiment in this energy range. An overview of the LAT instrument design and construction is presented which includes performance estimates with particular emphasis on how these apply to studies of microquasars. The nature and quality of the data that will be provided by the LAT is described with results from recent detailed simulations that illustrate the potential of the LAT to observe gamma ray variability and spectra.

NTIS

*Gamma Ray Telescopes; Hubble Space Telescope; Quasars; Spaceborne Telescopes*

**20070013847** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Imaging Thermal He(+) from the Lunar Surface**

Gallagher, D. L.; Sandel, B. R.; Goldstein, J.; Adrian, M. L.; Spasojevic, M.; Jahn, J.-M.; Dec. 15, 2006; 1 pp.; In English; 2006 Fall American Geophysical Union Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

Extreme ultraviolet observations of He(+) ions by the EUV instrument on the IMAGE spacecraft have dramatically improved our ability to observe plasmasphere dynamics in the inner magnetosphere. These primarily high latitude observations have revealed the phenomenology of thermal density structures and continue to lead us toward a more complete understanding of inner magnetospheric electric fields and plasmaspheric refilling. Recent analyses have brought attention to the disposition of thermal plasma eroded from the plasmasphere and convected into the outer dayside magnetosphere. The extent to which this plasma is lost into the solar wind or recirculated across the polar cap or through the magnetospheric flanks is an important outstanding question that relates to the influence this plasma has on space weather processes in Geospace. A concept for implementation of enhanced EUV observations from the lunar surface to resolve questions about the global circulation of He(+) plasma in the magnetosphere will be presented. The instrument and science package subsystem elements,

including anticipated component capabilities and limitations will be discussed. Attention will also be given to the potential impact of dust contamination.

Author

*Imaging Techniques; Lunar Surface; Helium Ions; Thermal Plasmas*

**20070013974** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **M3 Status and Science Discussion**

Pieters, Carle; February 13, 2007; 20 pp.; In English; Chandrayaan-1 Science Team Meeting, 12-13 Feb. 2007, Bangalore, India; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Members of the M3 Science Team will attend the Chandrayaan-I Science Team Meeting in Bangalore, India to present a brief summary of instrument status and the near-term milestones (e.g., final I&T, pre-ship review). The principal purpose of the meeting is to interact with other members of the Chandrayaan-I Science Team to prepare for successful science return. The objectives are: 1) Characterize the diversity and extent of different types of basaltic volcanism; 2) Constrain evolution over time; and 3) Examine high priority regional sites.

Author

*Volcanology; Basalt; Lunar Crust; Lunar Craters*

**20070013975** NASA, Washington, DC, USA

### **Mission to Jupiter: A History of the Galileo Project**

Meltzer, Michael; 2007; 182 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): W-91830

Report No.(s): NASA/SP-2007-4231; No Copyright; Avail.: CASI: [EA5](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070013975>

This book attempts to convey the creativity, leadership, and vision that were necessary for the Galileo mission's success. It is a book about dedicated people and their scientific and engineering achievements. The Galileo mission faced many significant problems. Some of the most brilliant accomplishments and work-arounds of the Galileo staff occurred precisely when these challenges arose. Throughout the mission, engineers and scientists found ways to keep the spacecraft operational from a distance of nearly half a billion miles, enabling one of the most impressive voyages of scientific discovery. The following chapters are included in the book and give a general overview of its contents: 1) The Importance of the Galileo Project; 2) From Conception to Congressional Approval; 3) The Struggle To Launch Galileo: Technical Difficulties and Political Opposition; 4) The Challenger Accident and Its Impact on the Galileo Mission; 5) The Galileo Spacecraft; 6) Galileo Deployment, the Inner Solar System Tour, and the Asteroid Belt; 7) The High-Gain Antenna Failure: A Disappointment and a Challenge; 8) Jupiter Approach and Arrival; 9) The Orbiter Tour; 10) Profiles of Selected People Important to the Mission; 11) Conclusion.

Derived from text

*Galileo Project; Galileo Spacecraft; Space Exploration; Interplanetary Flight; Histories*

**20070014071** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Status of the L2 and Lunar Charged Particle Environment Models**

Minow, Joseph I.; Diekmann, Anne M.; Blackwell, William C., Jr.; Jan. 11, 2007; 37 pp.; In English; 45th AIAA Aerospace Science Meeting, 8-11 Jan. 2007, Reno, NV, USA; Copyright; Avail.: CASI: [A03](#), Hardcopy

The L2 Charged Particle Environment (L2-CPE) model is an engineering tool which provides free field charged particle environments for distant magnetotail, magnetosheath, and solar wind environments. L2-CPE is intended for use in assessing contributions from low energy radiation environments (4.1 keV to few MeV) to radiation dose in thin materials used in construction of spacecraft to be placed in orbit about the Sun-Earth L2 point. This paper describes the status of the current version of the L2-CPE model including structure of the model used to organize plasma environments into solar wind, magnetosheath, and magnetotail environments, the algorithms used to estimate radiation fluence in sparsely sampled environments, the updated graphical user interface, and output options for flux and fluence environments. In addition, we describe the status and plans for updating the model to include environments relevant to lunar programs.

Author

*Charged Particles; Environment Models; Lunar Environment; Lunar Programs; Earth-Moon System; Lagrangian Equilibrium Points*



**20070014474** Oceaneering Space Systems, Houston, TX, USA

**Possible Mafic Patches in Scott Crater Highlight the Need for Resource Exploration on the Lunar South Polar Region**

Cooper, Bonnie L.; [2007]; 1 pp.; In English; Lunar Reconnaissance Orbiter High Resolution Image, 3-5 May 2007, Houston, TX, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNNJ05HI05C; No Copyright; Avail.: CASI: **A01**, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014474>

Possible areas of mafic material on the rim and floor of Scott crater (82.1 deg S, 48.5 deg E) are suggested by analysis of shadow-masked Clementine false-color-ratio images. Mafic materials common in mare and pyroclastic materials can produce more oxygen than can highlands materials, and mafic materials close to the south pole may be important for propellant production for a future lunar mission. If the dark patches are confirmed as mafic materials, this finding would suggest that other mafic patches may exist, even closer to the poles, which were originally mapped as purely anorthositic.

Derived from text

*Mineralogy; Lunar Craters; Selenology; Craters; In Situ Resource Utilization; Fuel Production; Oxygen Production; Lunar Resources; Lunar Surface; Polar Regions*

**20070014798** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Lunar Dust Charging by Photoelectric Emissions**

Abbas, M. M.; Tankosic, D.; Craven, P. D.; Spann, J. F.; LeClair, A.; West, E. A.; January 2007; 39 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: **C01**, CD-ROM: **A03**, Hardcopy

The lunar surface is covered with a thick layer of sub-micron/micron size dust grains formed by meteoritic impact over billions of years. The fine dust grains are levitated and transported on the lunar surface, as indicated by the transient dust clouds observed over the lunar horizon during the Apollo 17 mission. Theoretical models suggest that the dust grains on the lunar surface are charged by the solar UV radiation as well as the solar wind. Even without any physical activity, the dust grains are levitated by electrostatic fields and transported away from the surface in the near vacuum environment of the Moon. The current dust charging and levitation models, however, do not fully explain the observed phenomena. Since the abundance of dust on the Moon's surface with its observed adhesive characteristics has the potential of severe impact on human habitat and operations and lifetime of a variety of equipment, it is necessary to investigate the charging properties and the lunar dust phenomena in order to develop appropriate mitigating strategies. Photoelectric emission induced by the solar UV radiation with photon energies higher than the work function of the grain materials is recognized to be the dominant process for charging of the lunar dust, and requires measurements of the photoelectric yields to determine the charging and equilibrium potentials of individual dust grains. In this paper, we present the first laboratory measurements of the photoelectric efficiencies and yields of individual sub-micron/micron size dust grains selected from sample returns of Apollo 17, and Luna 24 missions, as well as similar size dust grains from the JSC-1 simulants. The measurements were made on a laboratory facility based on an electrodynamic balance that permits a variety of experiments to be conducted on individual sub-micron/micron size dust grains in simulated space environments. The photoelectric emission measurements indicate grain size dependence with the yield increasing by an order of magnitude for grains of sub-micron to several micron size radii, at which it reaches asymptotic values. The yield for large size grains is found to be more than an order of magnitude higher than the bulk measurements on lunar fines reported in the literature.

Author

*Lunar Dust; Photoelectric Emission; Lunar Surface; Levitation; Lunar Environment; Particle Charging*

## 92

### SOLAR PHYSICS

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

**20070013789** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Probing the Magnetic Causes of CMEs: Free Magnetic Energy More Important Than Either Size Or Twist**

Falconer, D. A.; Moore, R. L.; Gary, G. A.; Dec. 16, 2006; 1 pp.; In English; 2006 Fall American Geophysical Union Meeting, 11-16 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

To probe the magnetic causes of CMEs, we have examined three types of magnetic measures: size, twist and total nonpotentiality (or total free magnetic energy) of an active region. Total nonpotentiality is roughly the product of size times twist. For predominately bipolar active regions, we have found that total nonpotentiality measures have the strongest correlation with future CME productivity (approx. 75% prediction success rate), while size and twist measures each have a

weaker correlation with future CME productivity (approx. 65% prediction success rate) (Falconer, Moore, & Gary, ApJ, 644, 2006). For multipolar active regions, we find that the CME-prediction success rates for total nonpotentiality and size are about the same as for bipolar active regions. We also find that the size measure correlation with CME productivity is nearly all due to the contribution of size to total nonpotentiality. We have a total nonpotentiality measure that can be obtained from a line-of-sight magnetogram of the active region and that is as strongly correlated with CME productivity as are any of our total-nonpotentiality measures from deprojected vector magnetograms. We plan to further expand our sample by using MDI magnetograms of each active region in our sample to determine its total nonpotentiality and size on each day that the active region was within 30 deg. of disk center. The resulting increase in sample size will improve our statistics and allow us to investigate whether the nonpotentiality threshold for CME production is nearly the same or significantly different for multipolar regions than for bipolar regions. In addition, we will investigate the time rates of change of size and total nonpotentiality as additional causes of CME productivity.

Author

*Coronal Mass Ejection; Free Energy; Solar Physics; Geomagnetism*

## 93

### SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics*.

**20070013779** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Arc Testing of a Mockup Cable in a Simulated Space Radiation Environment**

Ferguson, D. C.; Schneider, T. A.; Vaughn, J. A.; [2007]; 1 pp.; In English; 45th AIAA Aerospace Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA; No Copyright; Avail.: Other Sources; Abstract Only

A mockup cable was irradiated with electrons of 25-100 keV energy in a vacuum chamber. The mockup cable consisted of insulated wires on a kapton substrate, overlaid with a metallized teonex shield. Voltages induced on the wires and shield by the electron beam during irradiation were monitored, and voltage changes were used, along with video, to detect arcs due to the charge built-up in the cable. The cable was also cooled with liquid nitrogen to very low temperatures, to simulate cables kept in the dark for long periods of time. Arcing was common at fluences typical of long space missions. Occasionally an arc would occur some time after the electron beam was turned off. The conductivity of the wires and shield was monitored as a function of temperature, and behaved as expected, with lower conductivities at lower temperatures. Arcs from the wires and shield to ground and from the wires to the shield were measured. Sympathetic arcs were also seen, wherein an arc from the shield to ground or from the wires to ground was followed in a short period of time by another arc of a different type. Implications of these results for real cables on long space missions will be discussed, and recommendations given for arc mitigation.

Author

*Simulation; Cables; Extraterrestrial Radiation; Aerospace Environments; Electric Arcs*

**20070013886** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Radiation Environments for Lunar Programs**

Minow, Joseph I.; Altstatt, Richard L.; Blackwell, William C.; Harine, Katherine J.; [2007]; 29 pp.; In English; Space Technology Applications International Forum 2007, 12-15 Feb. 2007, Biarritz, France; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Developing reliable space systems for lunar exploration and infrastructure for extended duration operations on the lunar surface requires analysis and mitigation of potential system vulnerabilities to radiation effects on materials and systems. This paper reviews the characteristics of space radiation environments relevant to lunar programs including the trans-Earth and trans-lunar injection trajectories through the Earth's radiation belts, solar wind surface dose environments, energetic solar particle events, and galactic cosmic rays and discusses the radiation design environments being developed for lunar program requirements to assure that systems operate successfully in the space environment.

Author

*Aerospace Environments; Lunar Programs; Extraterrestrial Radiation; Solar Corpuscular Radiation; Aerospace Systems*

**20070014073** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Genesis Radiation Environment**

Minow, Joseph I.; Altstatt, Richard L.; Skipworth, William C.; [2007]; 9 pp.; In English; 45th AIAA Aerospace Sciences Meeting, 8-11 Jan. 2007, Reno, NV, USA; Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

The Genesis spacecraft launched on 8 August 2001 sampled solar wind environments at L1 from 2001 to 2004. After the Science Capsule door was opened, numerous foils and samples were exposed to the various solar wind environments during periods including slow solar wind from the streamer belts, fast solar wind flows from coronal holes, and coronal mass ejections. The Survey and Examination of Eroded Returned Surfaces (SEERS) program led by NASA's Space Environments and Effects program had initiated access for the space materials community to the remaining Science Capsule hardware after the science samples had been removed for evaluation of materials exposure to the space environment. This presentation will describe the process used to generate a reference radiation Genesis Radiation Environment developed for the SEERS program for use by the materials science community in their analyses of the Genesis hardware.

Author

*Aerospace Environments; Genesis Mission; Coronal Mass Ejection; Coronal Holes; Exposure; Erosion; Extraterrestrial Radiation*

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