FY 2001 Scientific and Technical Reports, Articles, Papers, and Presentations

Compiled by
J.E. Turner Waits
Marshall Space Flight Center, Marshall Space Flight Center, Alabama

March 2002
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Marshall Space Flight Center, Marshall Space Flight Center, Alabama

National Aeronautics and
Space Administration

Marshall Space Flight Center • MSFC, Alabama 35812

March 2002
FOREWORD

In accordance with the NASA Space Act of 1958, the George C. Marshall Space Flight Center (MSFC) has provided for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Since July 1, 1960, when MSFC was organized, the reporting of scientific and engineering information has been considered a prime responsibility of the Center. Our credo has been that “research and development work is valuable, but only if its results can be communicated and made understandable to others.”

The N number shown for the reports listed is assigned by the Center for AeroSpace Information (CASI), Hanover, MD, indicating that the material is unclassified and unlimited and is available for public use. These publications can be purchased from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The N number should be cited when ordering.
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Since composite laminates are beginning to be identified for use in reusable launch vehicle propulsion systems, an understanding of their permeance is needed. A foreign object impact event can cause a localized area of permeability (leakage) in a polymer matrix composite, and it is the aim of this study to assess a method of quantifying permeability after impact results. A simple test apparatus is presented, and variables that could affect the measured values of permeability after impact were assessed. Once it was determined that valid numbers were being measured, a fiber/resin system was impacted at various impact levels and the resulting permeability measured, first with a leak check solution (qualitative), then using the new apparatus (quantitative). The results showed that as the impact level increased, so did the measured leakage. As the pressure to the specimen was increased, the leak rate was seen to increase in a nonlinear fashion for almost all the specimens tested.

A high frame rate digital video camera installed on test stands at Stennis Space Center (SSC) has been used to capture images of the aerospike engine plume during test. These plume images are processed in real time to detect and differentiate anomalous plume events. Results indicate that the High-Speed Observer (HSO) system can detect anomalous plume streaking events that are indicative of aerospike engine malfunction.

A video camera and recorder were placed inside the solid rocket booster forward skirt in order to view foam loss events over an area on the external tank (ET) intertank surface. In this Technical Memorandum, a method of processing video images to allow rapid detection of permanent changes indicative of foam loss events on the ET surface was defined and applied to accurately count, categorize, and locate such events.
This document provides a compilation of environments knowledge about the planet Mars. Information is divided into three categories: (1) Interplanetary space environments (environments required by the technical community to travel to and from Mars); (2) atmospheric environments (environments needed to acrocapture, aerobrake, or use aerocassist for precision trajectories down to the surface); and (3) surface environments (environments needed to have robots or explorers survive and work on the surface).


This document presents Mars Global Reference Atmospheric Model 2001 Version (Mars–GRAM 2001) and its new features. As with the previous version (Mars–2000), all parameterizations for temperature, pressure, density, and winds versus height, latitude, longitude, time of day, and season (Ls) use input data tables from NASA Ames Mars General Circulation Model (MGCM) for the surface through 80-km altitude and the University of Arizona Mars Thermospheric General Circulation Model (MTGCM) for 80 to 70 km. Mars–GRAM 2001 is based on topography from the Mars Orbiter Laser Altimeter (MOLA) and includes new MGCM data at the topographic surface. A new auxiliary program allows Mars–GRAM output to be used to compute shortwave (solar) and longwave (thermal) radiation at the surface and top of atmosphere. This memorandum includes instructions on obtaining Mars–GRAM source code and data files and for running the program. It also provides sample input and output and an example for incorporating Mars–GRAM as an atmospheric subroutine in a trajectory code.

TM–2001–210963 April 2001
Feasibility Study of Thin Film Thermocouple Piles (MSFC Center Director’s Discretionary Fund Final Report, Project No. 99–41). R.C. Sisk. Microgravity Science and Applications Department. 20010046480N

Historically, thermopile detectors, generators, and refrigerators based on bulk materials have been used to measure temperature, generate power for spacecraft, and cool sensors for scientific investigations. New potential uses of small, low-power thin film thermopiles are in the area of micro-electromechanical systems since power requirements decrease as electrical and mechanical machines shrink in size.

In this research activity, thin film thermopile devices are fabricated utilizing radio frequency sputter coating and photore sist lift-off techniques. Electrical characterizations are performed on two designs in order to investigate the feasibility of generating small amounts of power, utilizing any available waste heat as the energy source.

A “Kane’s Dynamics” Model for the Active Rack Isolation System. R.D. Hampton,* G.S. Beech, N.N.S. Rao,* J.K. Rupert,* and Y.K. Kim, Engineering Systems Department and *University of Alabama in Huntsville. 20010067152N

Many microgravity space science experiments require vibratory acceleration levels unachievble without active isolation. The Boeing Corporation’s Active Rack Isolation System (ARIS) employs a novel combination of magnetic actuation and mechanical linkages to address these isolation requirements on the International Space Station (ISS). ARIS provides isolation at the rack (International Standard Payload Rack (ISPR)) level.

Effective model-based vibration isolation requires (1) an appropriate isolation device, (2) an adequate dynamic (i.e., mathematical) model of that isolator, and (3) a suitable, corresponding controller. ARIS provides the ISS response to the first requirement. This paper presents one response to the second, in a state space framework intended to facilitate an optimal-controls approach to the third. The authors use “Kane’s Dynamics” to develop a state-space, analytical (algebraic) set of linearized equations of motion for ARIS.


The multipurpose hydrogen test bed (MHTB), with an 18-m³ liquid hydrogen tank, was used to evaluate a combination foam/multi layer combination insulation (MLI) concept. The foam element (Isofoam SS–1171) insulates during ground hold/ascent flight, and allowed a dry nitrogen purge as opposed to the more complex/heavy helium purge subsystem normally required. The 45-layer MLI was designed for an on-orbit storage period of 45 days. Unique MLI features include a variable layer density, larger but fewer double-aluminized Mylar perforations for ascent to orbit venting, and a commercially established roll-wrap installation process that reduced assembly man-hours and resulted in a robust, virtually seamless MLI. Insulation performance was measured during three test series. The spray-on foam insulation (SOFI) successfully prevented purge gas liquefaction within the MLI and resulted in the expected ground hold heat leak of 63 W/m². The orbit hold tests resulted in heat leaks of 0.085 and 0.22 W/m² with warm boundary temperatures of 164 and 305 K, respectively. Compared to the best previously measured performance with a traditional MLI system, a 41-percent heat leak reduction with 25 fewer MLI layers was achieved. The MHTB MLI heat leak is half that calculated for a constant layer density MLI.

Two graphite/epoxy cryogenic pressure vessels were evaluated for microcracking. The X-33 LH₂ tank lobe skins were extensively examined for microcracks. Specimens were removed from the inner skin of the X-33 tank for tensile testing. The data obtained from these tests were used to model expected microcrack density as a function of stress. Additionally, the laminate used in the Marshall Space Flight Center (MSFC) Composite Conformal, Cryogenic, Common Bulkhead, Aerogel-Insulated Tank (CBAT) was evaluated. Testing was performed in an attempt to predict potential microcracking during testing of the CBAT.
It is well known that direct measurements using electrodes of plasma jet electrical conductivity have utility in the development of explosively driven magnetohydrodynamic (MHD) energy converters as well as magnetic flux compression reaction chambers for nuclear/chemical pulse propulsion and power. Assuming that low-yield microfusion detonations or chemical detonations using high-energy density matter can eventually be realized in practice, various magnetic flux compression concepts are conceivable. In particular, reactors in which a magnetic field would be compressed between an expanding detonation-driven plasma cloud and a stationary structure formed from a high-temperature superconductor are envisioned. Primary interest is accomplishing two important functions: (1) Collimation and reflection of a hot diamagnetic plasma for direct thrust production, and (2) electric power generation for fusion standoff drivers and/or dense plasma formation. In this TP, performance potential is examined, major technical uncertainties related to this concept assessed, and a simple performance model for a radial-mode reactor developed. Flux trapping effectiveness is analyzed using a skin layer methodology, which accounts for magnetic diffusion losses into the plasma armature and the stationary stator. The results of laboratory-scale experiments on magnetic diffusion in bulk-processed type II superconductors are also presented.

Measurement of plasma jet electrical conductivity has utility in the development of explosively driven magnetohydrodynamic (MHD) energy converters as well as magnetic flux compression reaction chambers for nuclear/chemical pulse propulsion and power. Within these types of reactors, the physical parameter of critical importance to underlying MHD processes is the magnetic Reynolds number, the value of which depends upon the product of plasma electrical conductivity and velocity. Therefore, a thorough understanding of MHD phenomena at high magnetic Reynolds number is essential, and methods are needed for the accurate and reliable measurement of electrical conductivity in high-speed plasma jets. It is well known that direct measurements using electrodes suffer from large surface resistances, and an electrodeless technique is desired. To address this need, an inductive probing scheme, originally developed for shock tube studies, has been adapted. In this method, the perturbation of an applied magnetic field by a plasma jet induces a voltage in a search coil, which, in turn, can be used to infer electrical conductivity through the inversion of a Fredholm integral equation of the first kind. A 1-in.-diameter probe was designed and constructed, and calibration was accomplished by firing an aluminum slug through the probe using a light-gas gun. Exploratory laboratory experiments were carried out using plasma jets expelled from 15-g shaped charges. Measured conductivities were in the range of 4 kS/m for unseeded octol charges and 26 kS/m for seeded octol charges containing 2-percent potassium carbonate by mass.

The prospects for realizing an integrated pulse detonation propulsion and magnetohydrodynamic (MHD) power system are examined. First, energy requirements for direct detonation initiation of various fuel-oxygen and fuel-air mixtures are deduced from available experimental data and theoretical models. Second, the pumping power requirements for effective chamber scavenging are examined through the introduction of a scavenging ratio parameter and a scavenging efficiency parameter. A series of laboratory experiments were carried out to investigate the basic engineering performance characteristics of a pulse detonation-driven MHD electric power generator. In these experiments, stoichiometric oxy-acetylene mixtures seeded with a cesium hydroxide/methanol spray were detonated at atmospheric pressure in a 1-m-long tube having an i.d. of 2.54 cm. Experiments with a plasma diagnostic channel attached to the end of the tube confirmed the attainment of detonation conditions (\(p_D/p_1 \sim 34\) and \(D \sim 2,400\) m/sec) and enabled the direct measurement of current density and electrical conductivity (=6 S/m) behind the detonation wave front. In a second set of experiments, a 30-cm-long continuous electrode Faraday channel, having a height of 2.54 cm and a width of 2 cm, was attached to the end of the tube using an area transition duct. The Faraday channel was inserted in applied magnetic fields of 0.6 and 0.95 T, and the electrodes were connected to an active loading circuit to characterize power extraction dependence on load impedance while also simulating higher effective magnetic induction. The experiments indicated peak power extraction at a load impedance between 5 and 10 \(\Omega\). The measured power density was in reasonable agreement with a simple electrodynamic model incorporating a correction for near-electrode potential losses. The time-resolved thrust characteristics of the system were also measured, and it was found that the MHD interaction exerted a negligible influence.
on system thrust and that the measured \( I_{sp} \) of the system (200 sec) exceeded that computed for an equivalent nozzleless rocket (120 sec).

TP-2001–210962 April 2001
Estimating Cosmic-Ray Spectral Parameters From Simulated Detector Responses With Detector Design Implications. L.W. Howell. Space Science Department. 20010054957N

A simple power law model consisting of a single spectral index \( \alpha_1 \) is believed to be an adequate description of the galactic cosmic-ray (GCR) proton flux at energies below \( 10^{13} \) eV, with a transition at knee energy \( (E_k) \) to a steeper spectral index \( \alpha_2 > \alpha_1 \) above \( E_k \). The maximum likelihood procedure is developed for estimating these three spectral parameters of the broken power law energy spectrum from simulated detector responses. These estimates and their surrounding statistical uncertainty are being used to derive the requirements in energy resolution, calorimeter size, and energy response of a proposed sampling calorimeter for the Advanced Cosmic-ray Composition Experiment for the Space Station (ACCESS). This study thereby permits instrument developers to make important trade studies in design parameters as a function of the science objectives, which is particularly important for space-based detectors where physical parameters, such as dimension and weight, impose rigorous practical limits to the design envelope.

TP-2001–210989 May 2001
A Recommended Procedure for Estimating the Cosmic-Ray Spectral Parameter of a Simple Power Law With Applications to Detector Design. L.W. Howell. Space Science Department. 20010054955N

A simple power law model consisting of a single spectral index \( \alpha_1 \) is believed to be an adequate description of the galactic cosmic-ray (GCR) proton flux at energies below \( 10^{13} \) eV. Two procedures for estimating \( \alpha_1 \), the method of moments and maximum likelihood (ML), are developed and their statistical performance compared. It is concluded that the ML procedure attains the most desirable statistical properties and is hence the recommended statistical estimation procedure for estimating \( \alpha_1 \). The ML procedure is then generalized for application to a set of real cosmic-ray data and thereby makes this approach applicable to existing cosmic-ray data sets.

Several other important results, such as the relationship between collecting power and detector energy resolution, as well as inclusion of a non-Gaussian detector response function, are presented. These results have many practical benefits in the design phase of a cosmic-ray detector as they permit instrument developers to make important trade studies in design parameters as a function of one of the science objectives. This is particularly important for space-based detectors where physical parameters, such as dimension and weight, impose rigorous practical limits to the design envelope.

TP-2001–210991 May 2001

Ten-yr moving averages of the seasonal rates for “named storms,” tropical storms, hurricanes, and major (or intense) hurricanes in the Atlantic basin suggest that the present epoch is one of enhanced activity, marked by seasonal rates typically equal to or above respective long-term median rates. As an example, the 10-yr moving average of the seasonal rates for named storms is now higher than for any previous year over the past 50 yr, measuring 10.65 in 1994, or 2.65 units higher than its median rate of 8. Also, the 10-yr moving average for tropical storms has more than doubled, from 2.15 in 1955 to 4.60 in 1992, with 16 of the past 20 yr having a seasonal rate of 3 or more (the median rate). For hurricanes and major hurricanes, their respective 10-yr moving averages turned upward, rising above long-term median rates (5.5 and 2, respectively) in 1992, a response to the abrupt increase in seasonal rates that occurred in 1995. Taken together, the outlook for future hurricane seasons is for all categories of Atlantic basin tropical cyclones to have seasonal rates at levels equal to or above long-term median rates, especially during non-El Niño-related seasons. Only during El Niño-related seasons does it appear likely that seasonal rates might be slightly diminished.

TP-2001–210992 May 2001

Engineering design is a challenging activity for any product. Since launch vehicles are highly complex and interconnected and have extreme energy densities, their design represents a challenge of the highest order. The purpose of this document is to delineate and clarify the design process associated with the launch vehicle for space flight transportation. The goal is to define and characterize a baseline for the space transportation design process. This baseline can be used as a basis for improving effectiveness and efficiency of the design process. The baseline characterization is achieved via compartmentalization and technical integration of subsystems, design functions, and discipline functions. First, a global design process overview is provided in order to show responsibility, interactions, and connectivity of overall aspects of the design process. Then design essentials are delineated in
order to emphasize necessary features of the design process that are sometimes overlooked. Finally the design process characterization is presented. This is accomplished by considering project technical framework, technical integration, process description (technical integration model, subsystem tree, design/discipline planes, decision gates, and tasks), and the design sequence. Also included in the document are a snapshot relating to process improvements, illustrations of the process, a survey of recommendations from experienced practitioners in aerospace, lessons learned, references, and a bibliography.

TP-2001-211115 June 2001

Since 1750, the number of cataclysmic volcanic eruptions (volcanic explosivity index (VEI) ≥4) per decade spans 2-11, with 96 percent located in the tropics and extra-tropical Northern Hemisphere. A two-point moving average of the volcanic time series has higher values since the 1860's than before, being 8.00 in the 1910's (the highest value) and 6.50 in the 1980's, the highest since the 1910's peak. Because of the usual behavior of the first difference of the two-point moving averages, one infers that its value for the 1990's will measure ≈6.50 ± 1, implying that ≈7 ± 4 cataclysmic volcanic eruptions should be expected during the present decade (2000-2009). Because cataclysmic volcanic eruptions (especially those having VEI ≥5) nearly always have been associated with short-term episodes of global cooling, the occurrence of even one might confuse our ability to assess the effects of global warming. Poisson probability distributions reveal that the probability of one or more events with a VEI ≥4 within the next 10 yr is >99 percent. It is ≈49 percent for an event with a VEI ≥5, and 18 percent for an event with a VEI ≥6. Hence, the likelihood that a climatically significant volcanic eruption will occur within the next 10 yr appears reasonably high.
The next millennium challenges us to produce innovative materials, processes, manufacturing, and environmental technologies that meet low-cost aerospace transportation needs while maintaining U.S. leadership. The pursuit of advanced aerospace materials, manufacturing processes, and environmental technologies supports the development of safer operational, next-generation, reusable, and expandable aeronautical and space vehicle systems. The Aerospace Materials, Processes, and Environmental Technology Conference (AMPET) provided a forum for manufacturing, environmental, materials, and processes engineers, scientists, and managers to describe, review, and critically assess advances in these key technology areas.

The 2000 Microgravity Materials Science Conference was held June 6–8 at the Von Braun Center, Huntsville, Alabama. It was organized by the Microgravity Materials Science Discipline Working Group, sponsored by the Microgravity Research Division (MRD) at NASA Headquarters, and hosted by NASA Marshall Space Flight Center and the Alliance for Microgravity Materials Science and Applications (AMMSA). It was the fourth NASA conference of this type in the microgravity materials science discipline. The microgravity science program sponsored ≈200 investigators, all of whom made oral or poster presentations at this conference. In addition, posters and exhibits covering NASA microgravity facilities, advanced technology development projects sponsored by the NASA Microgravity Research Division at NASA Headquarters, and commercial interests were exhibited. The purpose of the conference was to inform the materials science community of research opportunities in reduced gravity and to highlight the Spring 2001 release of the NASA Research Announcement (NRA) to solicit proposals for future investigations. It also served to review the current research and activities in materials science, to discuss the envisioned long-term goals, and to highlight new crosscutting research areas of particular interest to MRD. The conference was aimed at materials science researchers from academia, industry, and government. A workshop on in situ resource utilization (ISRU) was held in conjunction with the conference with the goal of evaluating and prioritizing processing issues in Lunar and Martian type environments. The workshop participation included invited speakers and investigators currently funded in the material science program under the Human Exploration and Development of Space (HEDS) initiative. The conference featured a plenary session every day with an invited speaker that was followed by three parallel breakout sessions in subdisciplines. Attendance was close to 350 people. Posters were available for viewing during the conference and a dedicated poster session was held on the second day. Nanotechnology, radiation shielding materials, Space Station science opportunities, biomaterials research, and outreach and educational aspects of the program were featured in the plenary talks. This volume, the first to be released on CD-Rom for materials science, is comprised of the research reports submitted by the Principal Investigators at the conference.

The 2000 NASA Aerospace Battery Workshop was attended by scientists and engineers from various agencies of the U.S. Government, aerospace contractors, and battery manufacturers, as well as international participation in like kind from a number of countries around the world.

The subjects covered included nickel-hydrogen, lithium-ion, lithium-sulfur, and silver-zinc technologies.

The Tenth Thermal and Fluids Analysis Workshop (TFAWS 99) was held at the Bevill Center, University of Alabama in Huntsville, Huntsville, Alabama, September 13–17, 1999. The theme for the hands-on training workshop and conference was “Tools and Techniques Contributing to Engineering Excellence.” Forty-seven technical papers were presented in four sessions. The sessions were: (1) Thermal Spacecraft/Payloads, (2) Thermal Propulsion/Vehicles, (3) Interdisciplinary Paper, and (4) Fluids Paper. Forty papers were published in these proceedings. The remaining seven papers were not available in electronic format at the time of publication. In addition to the technical papers, there were (a) nine hands-on classes on thermal and flow analyses softwares, (b) twelve short courses, (c) thirteen product overview lectures, and (d) three keynote lectures. The workshop resulted in participation of 171 persons representing NASA Centers, Government agencies, aerospace industries, academia, software providers, and private corporations.
This report documents the development of analytical techniques required for interpreting and comparing space systems electromagnetic interference test data with commercial electromagnetic interference test data using NASA Specification SSP 30237A “Space Systems Electromagnetic Emission and Susceptibility Requirements for Electromagnetic Compatibility.” The PSpice computer simulation results and the laboratory measurements for the test setups under study compare well. The study results, however, indicate that the transfer function required to translate test results of one setup to another is highly dependent on cables and their actual layout in the test setup. Since cables are equipment specific and are not specified in the test standards, developing a transfer function that would cover all cable types (random, twisted, or coaxial), sizes (gauge number and length), and layouts (distance from the ground plane) is not practical.

This science data report describes the Optical Properties Monitor (OPM) experiment and the data gathered during its 9-mo exposure on the Mir space station. Three independent optical instruments made up OPM: an integrating sphere spectral reflectometer, vacuum ultraviolet spectrometer, and a total integrated scatter instrument. Selected materials were exposed to the low-Earth orbit, and their performance monitored in situ by the OPM instruments. Co-investigators from four NASA Centers, five International Space Station contractors, one university, two Department of Defense organizations, and the Russian space company, Energia, contributed samples to this experiment. These materials included a number of thermal control coatings, optical materials, polymeric films, nanocomposites, and other state-of-the-art materials. Degradation of some materials, including aluminum conversion coatings and Beta® cloth, was greater than expected.

The OPM experiment was launched aboard the Space Shuttle on mission STS–81 in January 1997 and transferred to the Mir space station. An extravehicular activity (EVA) was performed in April 1997 to attach the OPM experiment to the outside of the Mir/Shuttle Docking Module for space environment exposure. OPM was retrieved during an EVA in January 1998 and was returned to Earth on board the Space Shuttle on mission STS–89.

This systems report describes how the Optical Properties Monitor (OPM) experiment was developed. Pertinent design parameters are discussed, along with mission information and system requirements to successfully complete the mission. Environmental testing was performed on the OPM to certify it for spaceflight. This testing included vibration, thermal vacuum, electromagnetic interference and conductance, and toxicity tests. Instrument and monitor subsystem performances, including the reflectometer, vacuum ultraviolet, total integrated scatter, atomic oxygen monitor, irradiance monitor, and molecular contamination monitor during the mission are discussed.

The OPM experiment was launched aboard the Space Shuttle on mission STS–81 in January 1997 and transferred to the Mir space station. An extravehicular activity (EVA) was performed in April 1997 to attach the OPM experiment to the outside of the Mir/Shuttle Docking Module for space environment exposure. The OPM conducted in situ measurements of a number of material samples. These data may be found in the OPM Science Report. OPM was retrieved during an EVA in January 1998 and was returned to Earth on board the Space Shuttle on mission STS–89.

The goal of this program is to collect at one site much of the knowledge accumulated about the outgassing properties of aerospace materials based on ground testing, the effects of this outgassing observed on spacecraft in flight, and the broader contamination environment measured by instruments on-orbit. We believe that this Web site will help move contamination a step forward, away from anecdotal folklore toward engineering discipline. Our hope is that once operational, this site will form a nucleus for information exchange, that users will not only take information from our knowledgebase, but also provide new information from ground testing and space missions, expanding and increasing the value of this site to all. We urge Government and industry users to endorse this approach that will reduce redundant testing, reduce unnecessary delays, permit uniform comparisons, and permit informed decisions.
This Contractor Report describes and presents the results of work that was done in an attempt to develop an augmented acceleration technique that would launch small projectiles of known shape, mass, and state to velocities of 10 km/sec and higher. The higher velocities were to be achieved by adding a third stage to a conventional two-stage, light-gas gun and using a modified firing cycle for the third stage. The technique did not achieve the desired results and was modified for use during the development program. Since the design of the components used for the augmented-acceleration, three-stage launcher could be readily adapted for use as a three-stage launcher that used a single-stage acceleration cycle; the remainder of the contract period was spent performing test firings using the modified three-stage launcher. Work with the modified three-stage launcher, although not complete, did produce test firings in which an 0.11-g cylindrical nylon projectile was launched to a velocity of 8.65 km/sec.
ABBAS, M.M. SD50
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CRAYEN, P.D. SD50
WEST, E.A. SD50
PRATICO, J. UAH
SCHEIANU, D. UAH
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BANKS, C.E. SD47

Polydiacetylene as an All-Optical Picosecond Switch. For presentation at the SPIE Conference, San Diego, CA, July 29–August 2, 2001.

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SANDEL, B.R. University of Arizona


ADRIAN, M.L. SD50
GALLAGHER, D.L. SD50
GREEN, J.L. GSFC
SANDEL, B.R. University of Arizona


ADRIAN, M.L. SD50
HAMILTON, D.C. University of Maryland
HO, G.C. Johns Hopkins
MOORE, T.E. GSFC
POLLOCK, C.J. SwRI
MAGI, B.I. University of Arizona
HSIEH, K.C. University of Arizona

Scattering/Transmission of Energetic H\(^+\), He\(^+\), and O\(^+\) Through a Thin Composite Si/Lexan/C Foil. For presentation at the AGU Fall Meeting, San Francisco, CA, December 15–19, 2000.
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/Publicly Available. Dates are presentation dates.

ADRIAN, M.L. SD50
POLLOCK, C.J. SwRI
MOORE, T.E. GSFC
KINTNER, P.M., JR. Cornell University
ARNOLDY, R.L. University of New Hampshire


AHN, H.
ADAMS, J.H., JR. SD40
AMPE, J.
BASHINDZHAGYAN, G. Moscow State University
CASE, G.
ET AL.


ALEXANDER, D. Lockheed Martin
ASCHWANDE, M. Lockheed Martin
HURLBURT, N. Lockheed Martin
GARY, G.A. SD50


ANILKUMAR, A.V. Vanderbilt University
GRUGEL, R.N. SD47
LEE, C.P. Vanderbilt University


ANTHONY, M. ED25
MAJUMDAR, A.K. ED25


ATKINSON, P. University of Southampton, England
QUATTROCHI, D.A. SD60


BALLANCE, J. TD15
JOHNSON, L.


BANKS, C.E. Alabama A&M University
YELLESWARAPU, C. Alabama A&M University
SHARMA, A. Alabama A&M University
FRAZIER, D.O. SD47
PENN, B.G. SD47
ABDELDAYEM, H.A. SD47


BANKS, C.E. Alabama A&M University
ZHU, S. SD47
FRAZIER, D.O. SD01
PENN, B.G. SD47
ABDELDAYEM, H.A. USRA/SD47
SHARMA, A. Alabama A&M University


BARRET, C.

So What’s an RTG and Are They Safe? For presentation at the SWE National Conference, Denver, CO, June 1, 2001.

BASHINDZHAGYAN, G. Moscow State University
ADAMS, J.H., JR. SD50
BASHINDZHAGYAN, P. Moscow State University
CHILINGARIAN, A. Yerevan Physics Institute
DONNELLY, J. Dublin Institute
DRURY, L. Dublin Institute
EGOROV, N. Russian Research Institute
GOLUBKOV, S. Russian Research Institute
GREBENYUK, V. Joint Institute for Nuclear Research
ET AL.


BASHINDZHAGYAN, G. Moscow State University
ADAMS, J.H., JR. SD50
BASHINDZHAGYAN, P. Moscow State University
CHILINGARIAN, A. Yerevan Physics Institute
DONNELLY, J. Dublin Institute
DRURY, L. Dublin Institute
EGOROV, N. Russian Research Institute
GOLUBKOV, S. Russian Research Institute
GREBENYUK, V. Joint Institute for Nuclear Research
ET AL.

BAUGHER, C.R. SD45

BEECH, G.S. ED42
HAMPION, R.D. UAH

BERRY, S. MIT
HYERS, R.W. SD47
ABEDIAN, B. Tufts University
RAZ, L.M. Tufts University

BHAT, B.N. ED33
CARTER, R.W. ED33
DING, R.J. ED33
LAWLESS, K.G. ED33
NUNES, A.C., JR. ED33
RUSSELL, C.K. ED33
SHAH, S.R. ED33

BILLINGS, D. TD64

BINNS, W.R. Washington University
ADAMS, J.H., JR. SD50
BARBIER, L.M. GSFC
CHRISTIAN, E.R. GSFC
CRAIG, N. University of California
CUMMINGS, A.C. CA Institute of Technology
CUMMINGS, J.R. Washington University
DOKE, T. Waseda University
HASEBE, N. Waseda University
ET AL.

BITTEKER, L. TD40
BRAGG-SITTON, S.M. University of Michigan
LITCHFORD, R.J. TD40
Status of the Nuclear-Induced Conductivity Experiment (NICE) Project. For presentation at the 33d AIAA Plasmadynamics and Lasers Conference and the 14th International Conference on MHD, Maui, HI, May 20–23, 2002.

BLEVINS, J.A. TD40
PATTON, B. TD40
RIEYS, N.O. TD40
SCHMIDT, G.R. TD40

BOCCIPPIO, D.J. SD60

BOCCIPPIO, D.J. SD60
CHRISTIAN, H.J., JR. SD60
Applications of Satellite Total Lightning Observations. For presentation at the Eighth Scientific Assembly of IMAS, Munich, Germany, July 13, 2001.

BOCCIPPIO, D.J. SD60
CHRISTIAN, H.J., JR. SD60
The Future of Satellite-Based Lightning Detection. For presentation at the Eighth Scientific Assembly of IMAS, Munich, Germany, July 13, 2001.

BOCCIPPIO, D.J. SD60
HECKMAN, S.
REINO, N.O.
MILLY, P.C.D.
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BOCCIPPIO, D.J. SD60
KOSHK, W.J. SD60
BLAKESLEE, R.J. SD60
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BOECK, W. Niagara University
BOCCIPPIO, D.J. SD60
GOODMAN, S.J. SD60
CUMMINS, K. Global Atmospherics
CRAMER, J. Global Atmospherics

Confirmation of NLDN Long-Range Strike Locations

BOOKOUT, P.S. ED21
TINSON, I. Strada Antica di Collegno
FLEMING, P. Strada Antica di Collegno


BOXWELL, R.
BROMLEY, G.
WAGNER, R.
PAULS, D.
MAYNARD, B.

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BUTAS, J.P.
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SOWERS, T.S.


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CANNONE, J.J. University of Texas
BARNES, C.L. SD48
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HAMMOND, M.S.
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GRUGEL, R.N.

CARRINGTON, C.K. FD02
HOWELL, J.T. FD02
Technology Needs of Future Space Infrastructures Supporting Human Exploration and Development of Space.

CARRUTH, M.R., JR. ED31

CARSWELL, B. UAH
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BREEDING, S. SD47
ROSE, F. PWI

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CARTER, D.L. FD21

CASE, G. Louisiana State University
ELLISON, S. Louisiana State University
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ISBERT, J. Louisiana State University
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CASSIBRY, J.T. UAH
THIO, Y.C.F. TD40
WU, S.-T. UAH

CASSIBRY, J.T. UAH
THIO, Y.C.F. TD40
WU, S.-T. UAH
ESKRIDGE, R.E. TD40
SMITH, J. TD40
LEE, M.H. TD40
Interfacial Stability of Spherically Converging Plasma Jets for Magnetized Target Fusion. For presentation at the 42d Annual Meeting of the APS Division of Plasma Physics, Quebec, Canada, October 23–27, 2000.

CATALINA, A.V. USRA
SEN, S. USRA
CURRERI, P.A. SD47

CHA, S.S. University of Illinois
LESLIE, F.W. SD47
RAMACHANDRAN, N. SD47
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CHANDLER, M.O. SD50
CRAVEN, P.D. SD50
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CHANG, J. MPI fuer Aeronomie
SCHMIDT, W.K.H. MPI fuer Aeronomie
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CHANG, S.-W. SD50
SPANN, J.F., JR. SD50
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LEPPING, R.P.


CHEN, P. IIT Research Institute
MALONE, T.W. ED33
BOND, R. IIT Research Institute
TORRES, P. ED33


CHOU, S.-H. SD60


CHOU, S.-H. SD60
MILLER, T.L. SD60


CHRISTIAN, H.J., JR. SD60

Optical Lightning Detection From Space. Lecture at the University of Arizona, Tucson, AZ, November 6, 2000.
CLANTON, S.E. Sverdrup
HOLT, J.M. ED25


CLAYTON, J.L. ED25


CLAYTON, J.L. ED25


CLINTON, R.G., JR. SD10


COBB, S.D. SD47

VOLZ, M.P. SD47

SCHWEIZER, M. USRA

KAISER, N. University of Fribourg

CARPENTER, P.K. USRA

SZOFRAN, F.R. SD47


COCHRANE, J.C. USRA

ZHU, S. USRA

SU, C.-H. SD47

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COFFEY, V.N. SD50

MOORE, T.E. GSFC

CHANDLER, M.O. SD50

CRAVEN, P.D. SD50


COHEN, C. SD60


COOPER, K. ED34


COOPER, K. ED34

SALVAIL, P. IIT Research Institute


COUNTS, S.M. FD31

SLEDD, A.M. FD31


CRAIG, L. ED22


CRAIG, L. ED22

SMITHERS, M. ED22

NEIN, M. Pace & Waite

HADAWAY, J. CAO-UAH


Crozser, K.E.  Southern University


Cui, Y.  Fisk University

D’agostino, M.  TD63  LEE, Y.-C.  TD63  Wang, T.-S.  TD64  X-33 XRS-2200 Linear Aerospike Engine Sea Level Plume Radiation. For presentation at the MSFC Fluids
DANFORD, T.M.  FD31
MCLEMORE, C.  FD31
SCHNEIDER, W.F.  FD31

DAVIS, D.W.  ED23

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JOY, M.K.
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DELAY, T.K.  ED34

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DING, R.J.  ED33

DING, R.J.  ED33
ROMINE, P.L.  SD50
DORNÉY, S.M. TD64
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HUBER, F. Riverbend Design
SHEFFLER, D.A. The Agilis Group


DROEGE, A.R. TD64
WILLIAMS, R.W. TD64
GARCIA, R. TD64


DUARTE, L.A. TD01


DUMBACHER, D.L. TD20


EDWARDS, D.L. ED31
HUBBS, W.S. ED31
WERTZ, G.E. ED31
ALSTATT, R. ED31


EDWARDS, J.D. Sverdrup
UNGAR, E.K. JSC
HOLT, J.M. ED25

Assessment and Accommodation of Thermal Expansion of the Internal Active Thermal Control System Coolant During Launch to On-Orbit Activation of International Space Station Elements. For presentation at the 12th Thermal and Fluids Analysis Workshop, Huntsville, AL, September 10–14, 2001.

ELAM, S. TD61
LEE, J. TD61
HOLMES, R. TD61
ZIMMERMAN, F. TD61
EFFINGER, M. TD61


ELLIS, R.F. SD50
GLADSTONE, G.R. SwRI
WAITE, J.H., JR. University of Michigan
GRÖNERT, D.C. University of Michigan
CRAZY, F.J. University of Michigan
METZGER, A.E. JPL
HURLEY, K.C. University of California
FORD, P. MIT
WEISSKOPF, M.C. SD50

Chandra Observations of Io and the Io Plasma Torus. For presentation at the Two Years of Science With Chandra Symposium, Washington, DC, September 1–7, 2001.

EMRICH, W.J., JR. TD40

Gasdynamic Mirror Fusion Propulsion Experiment. For presentation at the 42d Annual Meeting of the APS Division of Plasma Physics, Quebec, Canada, October 23–27, 2000.

EMRICH, W.J., JR. TD40


ENG, R. SD73


ENGELHAUPT, D.E. UAH
RAMSEY, B.D. SD50
SPEEGLE, C. Raytheon Systems

MARTIN, A.K. TD40
SMITH, J.W. TD40
GRiffin, S.T. University of Memphis

ESTES, H. Morgan Research Corp.
LIGGIN, K. ED13
CRAWFORD, K. ED13

EVANS, S.W. ED44
Natural Hazards of the Space Environment. For publication in Aircraft Survivability, 2000.

FALCONER, D.A. UAH
MOORE, R.L. SD50
GARY, G.A. SD50

FALCONER, D.A. SD50
MOORE, R.L. SD50
PORTER, J.G. SD50
HATHAWAY, D.H. SD50

FAZELY, A.R.
GUNASINGHA, R.M.
AINH, H.
ADAMS, J.H., JR. SD40
AMPE, J.
BASHINDZHAGYAN, G. Moscow State University ET AL.

FIShMAN, G.J. SD50

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Gamma-Ray Bursts—An Update. For presentation at Auburn University, Auburn, AL, April 20–21, 2001.

FIShMAN, G.J. SD50

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MATTEI, J.A. AAVSO

FLACHBART, R.H. TD53
HEDAYAT, A. Sverdrup
HOLT, K.A. TD53

FREHILCH, R.G. University of Colorado
KAVAYA, M.J. SD50

FRENDI, K. UAH
NESMAN, T.E. TD63
WANG, T.-S. TD63

FREY, H.U. University of CA, Berkeley
MENDE, S.B. University of CA, Berkeley
CARLSON, C.W. University of CA, Berkeley
HEE Terks, H. University of CA, Berkeley
LAMPTON, M. University of CA, Berkeley
GELLER, S.P. University of CA, Berkeley
STOCK, J.M. University of CA, Berkeley

The Storm-Time Plasmasphere as Seen by the Extreme Ultraviolet (EUV) Imager on the IMAGE Spacecraft. For presentation at the Fall AGU Meeting, San Francisco, CA, December 15–19, 2000.


Initial Results From the Jovian Electrodynamic Tether Systems (JETS) Study. For presentation at the Forum on Innovative Approaches to Outer Planetary Exploration, Houston, TX, February 21–22, 2001.


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GATTIS, C.  ED21

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LAVERDE, B.  ERC, Inc.
HOWELL, M.  Qualis Corp.

GERMANY, G.A.  SD50
SONG, A.
RICHARDS, P.G.
CHUA, D.
BRITTNACHER, M.J.
PARKS, G.K.
SPANN, J.F., JR.

GERRISH, H.  TD40
SCHMIDT, G.R.
RODGERS, S.

GLADSTONE, G.R.
MENDE, S.B.
FREY, H.U.
GELLER, S.P.
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GERARD, J.-C.
HABRAKEN, S.
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GIBSON, H.  ED32

GILLIES, D.C.  SD47
LEWIS, W.S. SwRI
JAHN, J.-M. SwRI
BHARDWAJ, A. Vikram Sarabhai SC
CLARK, J.T. University of Michigan

ET AL.


GLADSTONE, G.R. SwRI
WAITE, J.H., JR. University of Michigan
GRODENT, D.C. University of Michigan
CRARY, F.J. University of Michigan
ELSNER, R.F. SD50
WEISSKOPF, M.C. SD50
LEWIS, W.S. SwRI
JAHN, J.-M. SwRI
BHARDWAJ, A. Vikram Sarabhai SC

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GOODRICH, R.G. Louisiana State University
LITCHFORD, R.J. TD15
ROBERTSON, T. TD40
SCHMIDT, D. ED33


GOSTOWSKI, R.C. ED36


GRAHAM, J.B. TD20


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WANG, Y. Alabama A&M University
SHARMA, A. Alabama A&M University


GRAY, P.A. ED31
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CARRUTH, M.R., JR. ED31


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GREENE, W.D. TD53


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GUBAREV, M. Raytheon ITSS
KESTER, T. SD70
TAKACS, P. Brookhaven National Lab

GUERRA, M. University of Texas, El Paso
MCCLURE, J.C. University of Texas, El Paso
MURR, L.E. University of Texas, El Paso
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GUERRA, M. University of Texas, El Paso
SCHMIDT, C. University of Texas, El Paso
MCCLURE, J.C. University of Texas, El Paso
MURR, L.E. University of Texas, El Paso
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HAINES, S.L. UAH
SUGGS, R.J. SD60
JEDLOVEC, G.J. SD60

HANSON, J.M. TD54

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HASTINGS, L.J. TD52
PLACHTA, D.W. Glenn Research Center
LALERNO, L. Ames Research Center
KITTEL, P. Ames Research Center

HATHAWAY, D.H. SD50
BECK, J.G. Stanford University
HAN, S. TN Tech University
RAYMOND, J. TN Tech University

HATHAWAY, D.H. SD50
GILMAN, P.A. HAO/NCAR
BECK, J.G. Stanford University

HAYS, C.C. CA Institute of Technology
SCHROERS, J. CA Institute of Technology
JOHNSON, W.L. CA Institute of Technology
RATHZ, T.J. UAH
HYERS, R.W. SD47
ROBINSON, M.B. SD47
The Vitrification and Determination of the Crystallization Time Scales of a Zr58.5Nb2.8Cu15.6Ni12.8Act10.3 Bulk Metallic Glass-Forming Liquid. For publication in the American Institute of Physics Journal, 2001.

HEATON, A.F. FD34
LONGUSKI, J.M. Purdue University
The Feasibility of a Galileo-Style Tour of the Uranian Satellites. For presentation at the AAS/AIAA Astrodynamics Specialists Conference, Quebec City, Quebec, Canada, July 30–August 2, 2001.

HEDAYAT, A. Sverdrup
HASTINGS, L.J. TD52
BROWN, T. TD30

HEDAYAT, A. Sverdrup
HASTINGS, L.J. TD52
SIMS, J.
PLACHTA, D.W. Glenn Research Center

HELMS, J.E. Louisiana State University
LI, G. Louisiana State University
SMITH, B.H. ED34

HENDERSON, R. SD10

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O'CONNOR, E.W. Hamilton Sundstrand
ZAGAJA, J. Hamilton Sundstrand
MURDOCH, K. Hamilton Sundstrand

HOLMES, R.E. SD42
ELAM, S. SD42
MCKECHNIE, T. Plasma Processes, Inc.
HICKMAN, R. Plasma Processes, Inc.

HOUTS, M.G. TD40
VAN DYKE, M.K. TD40
GODFROY, T.J. TD40
PEDERSEN, K.J. TD40
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MARTIN, J.J. TD40
WILLIAMS, E. TD40
HARPER, R. TD40
KIRKINDALL, S. TD40
LAPOINTE, M. Ohio Aerospace Inst.
VONDRA, R. TRW
DAILEY, C.L. RLD Associates
LOVBGER, R. RLD Associates
HUETER, U. TD15
Focus of NASA's Spaceline 100 Investment Area. For presentation at the Chemical Propulsion Information Agency/Airbreathing Propulsion Subcommittee, Monterey, CA, November 15, 2000.

HUETER, U. TD15

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HUFF, T.L. ED36

HULLEMAN, F. SD50
TENNANT, A.F. SD50
VAN KERKWIJK, M.H. SD50
KULKARNI, S.R. SD50
KOUELOJOTOU, C. USRA/S50
PATEL, S.K. SD50

HURLBERT, E. Johnson Space Center
MCNEAL, C.I. TD20

HUTT, J.J. TD15
MCARTHUR, J.C. TD15

HYERS, R.W. SD47
MOTAKEF, S. Cape Simulations, Inc.
WITT, A.F. MIT
WUENSCH, B. MIT

ISBERT, J. Louisiana State University
ADAMS, J.H., JR. SD50
AHN, H. GSFC
AMPE, J. Russian Academy of Sciences
BASHINDZHAGYAN, G. Moscow State University ET AL.

ISRAEL, M.H. Washington University
ADAMS, J.H., JR. SD50
BARBIER, L.M. GSFC
BINNS, W.R. Washington University
CHRISTIAN, E.R. GSFC
CRAIG, N. University of CA, Berkely
CUMMINGS, A.C. CA Institute of Technology
DOKE, T. Waseda University
HASEBE, N. Waseda University
ET AL.

JACOBS, W.A. ED17
GALABOFF, Z.J. ED17
WEST, M.E. ED17
Vehicle Dynamics Due to Magnetic Launch Propulsion. For presentation in Advances in Navigation and Control Technology Workshop, Redstone Arsenal, AL, November 1, 2000.

JARZEMBSKI, M.A. SD60
SRIVASTAVA, V. USRA
Remote Sensing of Aerosol Backscatter and Earth Surface Targets by Use of an Airborne Focused Continuous Wave CO2 Doppler Lidar Over Western North America. For presentation at the Workshop on Multi(Hyperspectral Sensors, Measurements, Modeling Simulation, Redstone Arsenal, AL, November 7–9, 2000.

JEDLOVEC, G.J. SD60
LAWs, K. UAH


Interstellar Propulsion Research Within NASA. For presentation at the 52d IAF, Toulouse, France, October 1–5, 2001.


Imaging the Sunyaev-Zel’dovich Effect in Clusters of Galaxies. For presentation at the High-Energy Astrophysics Division (HEAD) of the AAS, Honolulu, HI, November 6–10, 2000.


Characterization of a Multilayered Dielectric Transmissive Phase Modulator. For presentation at the International Society for Optical Engineers (SPIE) Annual Meeting, San Diego, CA, August 2, 2001.
KRIVORUTSKY, E.N. University of Fairbanks

KHAZANOV, G.V. SD50
KRIVORUTSKY, E.N. University of Fairbanks

KHAZANOV, G.V. SD50
LIEMOHN, M.W. SD50

KHAZANOV, G.V. SD50
LIEMOHN, M.W. University of Michigan

KHAZANOV, G.V. SD50
STONE, N.H. SRS Technologies

KINTNER, P.M., JR. Cornell University
MEIER, R.R. Naval Research Lab
SPANN, J.F., JR. SD50

KITTEDGE, K.B. ED26

KOCZOR, R.J. SD01
PHILLIPS, T. SD01

KOSHBOS, W.J. SD60
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KOUVELIOTOU, C. SD50
TENNANT, A.F. USRA
WOODS, P.M. SD50
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HURLEY, K.C.
FENDER, R.P.
GARRINGTON, S.T.
PATEL, S.K.
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QUI, H.-L. California State University
QUATTROCHI, D.A. SD60
EMERSON, C.W. Western Michigan University
LANSING, M.D. ED34
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LANSING, M.D. ED34
RUSSELL, S.S. ED32
WALKER, J.L. ED32

LAPENTA, W.M. SD60
BLACKWELL, K. University of South Alabama
SUGGS, R.J. SD60
MCNIDER, R.T. UAH
JEDLOVEC, G.J. SD60
KIMBALL, S. University of South Alabama

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LAROQUE, S.J.
REESE, E.D.
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COE, M.J. Southampton University
HARMON, B.A. SD50
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ESTES, M.G., JR. USRA
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HAMIDZADEH, H. 
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RUSSELL, C. 
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LU, X. Dartmouth Medical
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THIO, Y.C.F. TD40
SLOUGH, J. University of Washington


MARTIN, J.J. TD40
LEWIS, R.A. TD40
CHAKRABARTI, S. TD40
PEARSON, J.B. TD40


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MCLAUL, E.W., JR. USRA
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KRAMER, K. Penn State University
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SMITH, G. Synergistic Tech, Inc.


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MEADE, B.R.  TD51
TALLEY, D.  AFRL
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FREY, H.U.  University of CA
GERARD, J.-C.  University of Liege
HUBERT, B.  University of Liege
FUSELIER, S.  Lockheed-Martin
SPANN, J.F., JR.  SD50
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BURCH, J.L.  SwRI

MINOR, J.L.  ED03

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MITROFANOV, I.G.
SANIN, A.B.
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BRIGGS, M.S.
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MONTGOMERY, E.E., IV  SD71

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NEWMAN, R.L. DAVIDSON, J.L. Vanderbilt University

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ERICKSON, D.J., III ORNL/CSM
ROADS, J.O. SIO/UCSD
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OGLESBY, R.J. PURDUE UNIVERSITY
MARSHALL, S. SD60
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DENG, Z.T.  Alabama A&M University
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SCHAEFER, D.A.  SD44
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UMBANHOWER, P. Northwestern University
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VAIDYANATHAN, R.  University of Florida
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BARNES, D.C.  Los Alamos National Laboratory
DEGNAN, J.  Air Force Research Laboratory
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SMITH, S.B.  NWS Meteorological Lab
PACE, D.
GOODMAN, S.J.  SD60
BURGESS, D.W.
SMARSH, D.
ROBERTS, R.D.
WOLFSON, M.M.


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WITHROW, W.K. SD48  
COIMBRA, C.F.M. University of Hawaii  
RANGEL, R. University of California  

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UNDERWOOD, D.B. FD35  
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VAISBERG, O.L. GSFC  
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POSTON, D. Los Alamos National Laboratory  
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