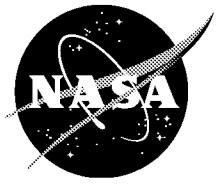
NASA/TM—2002–211626



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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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."

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GEORGE C. MARSHALL SPACE FLIGHT CENTER
Marshall Space Flight Center, Alabama

FY 2001 SCIENTIFIC AND TECHNICAL REPORTS,
ARTICLES, PAPERS, AND PRESENTATIONS

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TM–2000–210615 November 2000

NASA Microgravity Research Program Annual Report (1999). D.R. Woodard, Editor. Microgravity Research Program Office. 20010019433N

The Fiscal Year 1999 Annual Report describes key elements of the NASA Microgravity Research Program. The Program's goals, approach taken to achieve those goals, and program resources are summarized. A review of the Program's status at the end of FY1999 and highlights of the ground and flight research are provided.

TM–2001–210795 January 2001

FY 2000 Scientific and Technical Reports, Articles, Papers, and Presentations. J.E. Turner Waits, Compiler. Information Services Department. 20010020952N

This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY 2000. It also includes papers of MSFC contractors.

After being announced in STAR, all the NASA series reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

The information in this report may be of value to the scientific and engineering community in determining what information has been published and what is available.

TM–2001–210798 February 2001

High-Speed Observer: Automated Streak Detection in SSME Plumes. T.J. Rieckhoff, M.A. Covan,* and J.M. O'Farrell.* Vehicle and Systems Development Department and *United Space Alliance. 20010021695N

A high frame rate digital video camera installed on test stands at Stennis Space Center has been used to capture images of Space Shuttle main engine plumes during test. These plume images are processed in real time to detect and differentiate anomalous plume events occurring during a time interval on the order of 5 msec. Such speed yields near instantaneous availability of information concerning the state of the hardware. This information can be monitored by the test conductor or by other computer systems, such as the integrated health monitoring system processors, for possible test shutdown before occurrence of a catastrophic engine failure.

TM–2001–210799 February 2001

Permeability Testing of Impacted Composite Laminates for Use on Reusable Launch Vehicles. A.T. Nettles. Materials, Manufacturing, and Processes Department. 20010020948N

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.

TM–2001–210879 June 2001

High-Speed Observer: Automated Streak Detection for the Aerospike Engine. T.J. Rieckhoff, M.A. Covan,* and J.M. O'Farrell.* Vehicle and Systems Development Department and *United Space Alliance. 20010066069N

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.

TM–2001–210880 June 2001

Photographic Analysis Technique for Assessing External Tank Foam Loss Events. T.J. Rieckhoff, M.A. Covan,* and J.M. O'Farrell.* Vehicle and Systems Development Department and *United Space Alliance. 20010068033N

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.

TM–2001–210935 March 2001

Mars Transportation Environment Definition Document. M. Alexander, Editor. Engineering Systems Department. 20010046858N

This document provides a compilation of environments knowledge about the planet Mars. Information is divided into three catagories: (1) Interplanetary space environments (environments required by the technical community to travel to and from Mars); (2) atmospheric environments (environments needed to aerocapture, aerobrake, or use aeroassist for precision trajectories down to the surface); and (3) surface environments (environments needed to have robots or explorers survive and work on the surface).

TM–2001–210961 April 2001

Mars Global Reference Atmospheric Model 2001 Version (Mars–GRAM 2001): Users Guide. C.G. Justus* and D.L. Johnson. Engineering Systems Department and *Computer Sciences Corporation. 20010056680N

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 paramerizations 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 photoresist 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.

TM–2001–211063 May 2001

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 unachievable 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.

TM–2001–211089 June 2001

Large-Scale Liquid Hydrogen Testing of Variable Density Multilayer Insulation with a Foam Substrate. J.J. Martin and L. Hastings. Vehicle and Systems Development Department. 20010063699N

The multipurpose hydrogen test bed (MHTB), with an 18-m^3 liquid hydrogen tank, was used to evaluate a combination foam/multilayer 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/m^2. The orbit hold tests resulted in heat leaks of 0.085 and 0.22 W/m^2 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.

TM–2001–211143 July 2001

Science Directorate Publications and Presentations January 1–December 31, 2000. F.G. Summers, Compiler. Science Directorate. 20010072236N

This document lists the significant publications and presentations of the Science Directorate during the period January 1–December 31, 2000. Entries in the main part of the document are categorized according to NASA Reports (arranged by report number), Open Literature, and Presentations (arranged alphabetically by title). Also included for completeness is an Appendix (arranged by page number). Most of the articles listed under Open Literature have appeared in refereed professional journals, books, monographs, or conference proceedings. Although many published abstracts are eventually expanded into full papers for publication in scientific and technical journals, they are often sufficiently comprehensive to include the significant results of the research reported. Therefore, published abstracts are listed separately in a subsection under Open Literature. Questions or requests for additional information about the entries in this report should be directed to Dr. A.F. Whitaker (SD01; (256) 544–2481) or to one of the authors.

TM–2001–211194 August 2001

Evaluation of Microcracking in Two Carbon-Fiber/Epoxy-Matrix Composite Cryogenic Tanks. A.J. Hodge. Materials, Processes, and Manufacturing Department. 20010080458N

Two graphite/epoxy cryogenic pressure vessels were evaluated for microcracking. The X–33 LH_2 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.

TP–2001–210793 January 2001

Magnetic Flux Compression Reactor Concepts for Spacecraft Propulsion and Power (MSFC Center Director's Discretionary Fund Final Report; Part 1, Project No. 99–24). R.J. Litchford, G.A. Robertson, C.W. Hawk,* M.W. Turner,* and S. Koelfgen.* Advanced Space Transportation Program and *University of Alabama in Huntsville. 20010028795N

This technical publication (TP) examines performance and design issues associated with magnetic flux compression reactor concepts 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 accessed, 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.

TP–2001–210794 January 2001

Inductive Measurement of Plasma Jet Electrical Conductivity (MSFC Center Director's Discretionary Fund Final Report; Part II, Project No. 99–24). M.W. Turner,* C.W. Hawk,* and R.J. Litchford. Advanced Space Transportation Program and *Propulsion Research Center, University of Alabama in Huntsville. 20010029205N

Measurement of plasma jet electrical conductivity has utility in the development of explosively driven magneto-hydrodynamic (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.

TP–2001–210801 January 2001

Integrated Pulse Detonation Propulsion and Magneto-hydrodynamic Power. R.J. Litchford. Advanced Space Transportation Program. 20010022240N

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 ($p_2/p_1 \sim 34$ and D ~ 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 Ω. The measured power density was in reasonable agreement with a simple electrodynamic model incorporating a correction for near-electrode potential loses. 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 (α_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 α_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 α_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 α_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

Decadal Trends of Atlantic Basin Tropical Cyclones (1950–1999). Robert M. Wilson. Space Science Department. 20010055832N

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

Launch Vehicle Design Process: Characterization, Technical Integration, and Lessons Learned. J.C. Blair,* R.S. Ryan,* L.A. Schutzenhofer,* and W.R. Humphries. Structures and Dynamics Laboratory and *AI Signal Research, Inc. 20010066713N

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

An Estimate of the Likelihood of Significant Eruptions During 2000–2009 Using Poisson Statistics on Two-Point Moving Averages of the Volcanic Time Series. Robert M. Wilson. Space Science Department. 20010073812N

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 $\approx 6.50 \pm 1$, implying that $\approx 7 \pm 4$ 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.

CP–2001–210427 February 2001

Proceedings of the Fourth Conference on Aerospace Materials, Processes, and Environmental Technology. D.E. Griffin, D. Cross Stanley, and C. Shea, Editors. Materials, Processes, and Manufacturing Department.

20010067226N

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.

CP–2001–210827 March 2001

Microgravity Materials Science Conference 2000. N. Ramachandran,* N. Bennett,* D. McCauley,** K. Murphy,*** and S. Poindexter,* Editors. *Universities Space Research Association, **University of Alabama in Huntsville, and ***Morgan Research Corporation.

20010057199N (Vol. 1)
20010057256N (Vol. 2)
20010057302N (Vol. 3)

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.

CP–2001–210883 March 2001

The 2000 NASA Aerospace Battery Workshop. J.C. Brewer, Compiler. Avionics Department.

20010083604N

This document contains the proceedings of the 33d annual NASA Aerospace Battery Workshop, hosted by the Marshall Space Flight Center on November 14–16, 2000. The 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.

CP–2001–211141 July 2001

The 10th Thermal and Fluids Analysis Workshop. A. Majumdar, Compiler. Structures, Mechanics, and Thermal Department. Not Available Yet

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.

CR–2000–210400 November 2000

Comparison of Commercial Electromagnetic Interference Test Techniques to NASA Electromagnetic Interference Test Techniques. H.30231D. V. Smith. Space Environments and Effects (SEE) Program.
20010022107N

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.

CR–2001–210881 March 2001

Science Data Report for the Optical Properties Monitor (OPM) Experiment. NAS8–39237. D.R. Wilkes and J.M. Zwiener. Materials, Processes, and Manufacturing Department. 20010041341N

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.

CR–2001–210882 March 2001

System Report for the Optical Properties Monitor (OPM) Experiment. NAS8–39237. L. Hummer. Materials, Processes, and Manufacturing Department.
20010028796N

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.

CR–2001–210909 March 2001

Satellite Contamination and Materials Outgassing Knowledgebase—An Interactive Database Reference. NAS8–98215. D.B. Green. Space Environments and Effects (SEE) Program. 20010041071N

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 onorbit. 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.

CR–2001–210990 May 2001
A New Technique for Achieving Impact Velocities Greater Than 10 km/sec. NAS8-98216. A.J. Piekutowski. Space Environments and Effects (SEE) Program.
20010066711N

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.

CR—2001–210993 July 2001
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Alternate Propulsion Subsystem Concepts Volume II—Final Report (6 April 1992–30 April 2000). NAS8–39210. The Boeing Company.

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CR—2001–210996 July 2001
Measurement of Injector Face Temperature Using Optical Diagnostic Techniques—Final Report (6/30/98–9/30/98). NAS8–97095. The University of Alabama in Huntsville.

CR—2001–210997 June 2000
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MENDE, S.B.
LEPPING, R.P.
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MALONE, T.W. ED33
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CHOU, S.-H. SD60
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CLANTON, S.E. Sverdrup
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CRAMER, J.M. TD51
LEHMAN, M. Penn State University
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SANTORO, R.J. Penn State University
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MOZER, F. University of CA
RUSSELL, C.T. University of CA
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CRAWFORD, K. ED13
JOHNSON, M. ED12
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Second-Generation Reusable Launch Vehicle Potential Commercial Development Scenarios. For presentation at the 52d International Astronautical Congress, Toulouse, France, October 1–5, 2001.

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KAISER, N. University of Frieberg
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SMITH, B.H. ED34
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PRICKETT, T. ED25
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HOLZAPFEL, W.L.
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KAISER, N. University of Frieberg
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Unsteady Flow in a Supersonic Turbine With Variable Specific Heats. For presentation at the 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Salt Lake City, UT, July 8–11, 2001.

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WILLIAMS, R.W. TD64
GARCIA, R. TD64
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Space Transportation Directorate Risk Management Implementation Program. For presentation at the 22d American Society of Engineering Management (ASEM) National Conference, Huntsville, AL, October 10–13, 2001.

DUMBACHER, D.L. TD20
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HUBBS, W.S. ED31
WERTZ, G.E. ED31
ALSTATT, R. ED31
Space Environmental Effects Testing and Characterization of the Candidate Solar Sail Material Aluminized Mylar. For presentation at the NASA/JPL/MSFC/UAH 12th Annual Advanced Space Propulsion Workshop, Huntsville, AL, April 3–5, 2001.

EDWARDS, J.D. Sverdrup
UNGAR, E.K. JSC
HOLT, J.M. ED25
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ELAM, S. TD61
LEE, J. TD61
HOLMES, R. TD61
ZIMMERMAN, F. TD61
EFFINGER, M. TD61
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CRAVEN, P.D. SD50
MOORE, T.E. GSFC
RUSSELL, C.T. University of CA
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GLADSTONE, G.R. SwRI
WAITE, J.H., JR. University of Michigan
GRODENT, D.C. University of Michigan
CRARY, F.J. University of Michigan
METZGER, A.E. JPL
HURLEY, K.C. University of California
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ET AL.
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ENG, R. SD73
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RAMSEY, B.D. SD50
SPEEGLE, C. Raytheon Systems
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THIO, Y.C.F. TD40
LEE, M.H. TD40

MARTIN, A.K. TD40
SMITH, J.W. TD40
GRIFFIN, S.T. University of Memphis
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ESTES, H. Morgan Research Corp.
LIGGIN, K. ED13
CRAWFORD, K. ED13
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PORTER, J.G. SD50
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MATTEI, J.A. AAVSO
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FLACHBART, R.H. TD53
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Modeling and Test Data Analysis of a Tank Rapid Chill and Fill System for the Advanced Shuttle Upper Stage (ASUS) Concept. For presentation at the Cryogenic Engineering Conference, Madison, WI, July 16–20, 2001.

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WANG, T.-S. TD63
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MENDE, S.B. University of CA, Berkeley
CARLSON, C.W. University of CA, Berkeley
HEETDERKS, H. University of CA, Berkeley
LAMPTON, M. University of CA, Berkeley
GELLER, S.P. University of CA, Berkeley
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GARBE, G.P. SD50
MOORE, J. SRS Technologies
TALLEY, C. SRS Technologies
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GARAND, L. MSC
TURNER, D.S. MSC
LAROCQUE, M. MSC
BATES, J. NOAA
BOUKABARA, S. AR
BRUNEL, P. Meteo-France
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GARMIRE, G. PSU
ELSNER, R.F. SD50
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LAVERDE, B. ERC, Inc.
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SONG, A.
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RODGERS, S. TD40

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ENGEL, H.P. Wyle Labs

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LITCHFORD, R.J. TD15
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SCHMIDT, D. ED33

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GRANT, J. SD72
WANG, Y. Alabama A&M University
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Some Novel Solidification Processing Techniques Being Investigated at MSFC—Their Extension for Study Aboard the *ISS*. For presentation at the Conference on *International Space Station* Utilization, Kennedy Space Center, FL, October 15–18, 2001.

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KESTER, T. SD70
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Some Interplanetary Missions Using IEC Fusion Propulsion. For presentation at the U.S.-Japanese Exchange and IEC Workshop, Marshall Space Flight Center, AL, March 22, 2001.

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SCHROERS, J. CA Institute of Technology
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RATHZ, T.J. UAH
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MOTAKEF, S. Cape Simulations, Inc.
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SRIVASTAVA, V. USRA

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FORK, R.L. UAH
NELSON, T.R. Air Force Research Lab
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Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 2002	Technical Memorandum

4. TITLE AND SUBTITLE

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

5. FUNDING NUMBERS

6. AUTHORS

J.E. Turner Waits, Compiler

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES)

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

8. PERFORMING ORGANIZATION REPORT NUMBER

M–1044

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Washington, DC 20546

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

NASA/TM—2002–211626

11. SUPPLEMENTARY NOTES

Prepared by Information Services Department, Center Operations Directorate

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified-Unlimited
Subject Category 99
Availability: NASA CASI (301) 621–0390
Nonstandard Distribution

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

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The information in this TM may be of value to the scientific and engineering community in determining what information has been published and what is available.

14. SUBJECT TERMS

Scientific and Technical Report, Articles, Papers, Presentations

15. NUMBER OF PAGES

72

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited