FOREWORD

In accordance with the NASA Space Act of 1958, the MSFC has provided for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Since July 1, 1960, when the George C. Marshall Space Flight Center 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.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA TECHNICAL MEMORANDA</td>
<td>1</td>
</tr>
<tr>
<td>NASA TECHNICAL PUBLICATIONS</td>
<td>7</td>
</tr>
<tr>
<td>NASA SPECIAL PUBLICATION</td>
<td>11</td>
</tr>
<tr>
<td>MSFC CONFERENCE PUBLICATIONS</td>
<td>12</td>
</tr>
<tr>
<td>NASA CONTRACTOR REPORTS</td>
<td>13</td>
</tr>
<tr>
<td>MSFC PAPERS CLEARED FOR PRESENTATION</td>
<td>14</td>
</tr>
<tr>
<td>INDEX</td>
<td>59</td>
</tr>
</tbody>
</table>
Prior to the test it had been expected that the beam would lay down a static charge on the cloth and be deflected without damaging the cloth. The burnthrough is thought to be an effect of partial transmission of beam power by a stream of positive ions generated by the high-voltage electron beam from contaminant gas in the "vacuum" chamber. A rough quantitative theoretical computation appears to substantiate this possibility.

An 8-kv electron beam with a current in the neighborhood of 100 mA from the Ukrainian space welding "Universal Hand Tool" (UHT) burned holes in Nextel AF-62 ceramic cloth designed to withstand temperatures up to 1,427 °C. The burnthrough time was on the order of 8 sec at standoff distances between UHT and cloth ranging from 6–24 in. At both closer (2 in.) and farther (48 in.) standoff distances the potency of the beam against the cloth declined and the burnthrough time went up significantly.
and the pin tool's wear was excessive such that the pin tool length has to be manually adjusted for every 5 ft of weldment. Initially, boron-carbide coating was developed for pin tools, but it did not show a significant improvement in wear resistance. Basically, FSW is applicable mainly for butt joining of flat plates. Therefore, FSW of cylindrical articles such as a flange to a duct with practical diameters ranging from 2–5 in. must be fully demonstrated and compared with other proven MMC joining techniques for cylindrical articles.

TM–1999–209877 December 1999

This paper describes the results of a team effort aimed at defining the information flow between disciplines at the Marshall Space Flight Center (MSFC) engaged in the design of space launch vehicles. The information flow is modeled at a first level and is described using three types of templates: an N×N diagram, discipline flow diagrams, and discipline task descriptions. It is intended to provide engineers with an understanding of the connections between what they do and where it fits in the overall design process of the project. It is also intended to provide design managers with a better understanding of information flow in the launch vehicle design cycle.


This technical memorandum documents the results of the research to develop a concept for assessing the structural integrity of impacted composite structures using the strength degradation factor in conjunction with
available finite element tools. For this purpose, a literature search was conducted, a plan for conducting impact testing on two laminates was developed, and a finite element model of the impact process was created. Specimens for the impact testing were fabricated to support the impact testing plan.


The Linear Aerospike SR–71 Experiment (LASRE) was performed in support of the Reusable Launch Vehicle (RLV) program to help develop a linear aerospike engine. The objective of this program was to operate a small aerospike engine at various speeds and altitudes to determine how slipstreams affect the engine’s performance. The joint program between government and industry included NASA’s Dryden Flight Research Center, the Air Force’s Phillips Laboratory, NASA’s Marshall Space Flight Center, Lockheed Martin Skunkworks, Lockheed-Martin Astronautics, and Rocketdyne Division of Boeing North American. Ground testing of the LASRE engine produced two successful hot-fire tests, along with numerous cold flows to verify sequencing and operation before mounting the assembly on the SR–71. Once installed on the aircraft, flight testing performed several cold flows on the engine system at altitudes ranging from 30,000 to 50,000 feet and Mach numbers ranging from 0.9 to 1.5. The program was terminated before conducting hot-fires in flight because excessive leaks in the propellant supply systems could not be fixed to meet required safety levels without significant program cost and schedule impacts.

Rapid Production of Composite Prototype Hardware (MSFC Center Director’s Discretionary Fund Final Report, Project No. 96–02). T.K. DeLay. Materials, Processes, and Manufacturing Department. 20000050473N

The objective of this research was to provide a mechanism to cost-effectively produce composite hardware prototypes. The task was to take a hands-on approach to developing new technologies that could benefit multiple future programs.

This report details the results of a series of fluid motion experiments to investigate the use of magnets to orient fluids in a low-gravity environment. The fluid of interest for this project was liquid oxygen (LO₂) since it exhibits a paramagnetic behavior (is attracted to magnetic fields). However, due to safety and handling concerns, a water-based ferromagnetic mixture (produced by Ferrofluidics Corporation) was selected to simplify procedures. Three ferromagnetic fluid mixture strengths and a nonmagnetic water baseline were tested using three different initial fluid positions with respect to the magnet. Experiment accelerometer data were used with a modified computational fluid dynamics code termed CFX–4 (by AEA Technologies) to predict fluid motion. These predictions compared favorably with experiment video data, verifying the code’s ability to predict fluid motion with and without magnetic influences. Additional predictions were generated for LO₂ with the same test conditions and geometries used in the testing. Test hardware consisted of a cylindrical Plexiglas tank (6–in. bore with 10–in. length), a 6,000-G rare Earth magnet (10–in. ring), three-axis accelerometer package, and a video recorder system. All tests were conducted aboard the NASA Reduced-Gravity Workshop, a KC–135A aircraft.

This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY99. It also includes papers of MSFC contractors. All of the NASA series reports may be obtained from the NASA Center for Aerospace Information (CASI), 7121 Standard Drive, Hanover, MD 21076–1320.

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—1999–210131 May 1999

This technical memorandum presents a summary by the Electromagnetics and Aerospace Environments Branch at the Marshall Space Flight Center of lightning characteristics and lightning criteria for the protection of aerospace vehicles. Probability estimates are included for certain lightning strikes (peak currents of 200, 100, and 50 kA) applicable to the National Aeronautics and Space Administration Space Shuttle at the Kennedy Space Center, Florida during rollout, on-pad and boost/launch phases. Results of an extensive literature search to compile information on this subject are presented in order to answer key questions posed by the Space Shuttle Program Office at the Johnson Space Center concerning peak lightning current probabilities if a vehicle is hit by a lightning cloud-to-ground stroke. Vehicle-triggered lightning probability estimates for the aforementioned peak currents are still being worked. Section 4.5, however, does provide some insight on estimating these same peaks.


Electrical impedance spectrometry involves measurement of the complex resistance of a load at multiple frequencies. With this information in the form of impedance magnitude and phase, or resistance and reactance, basic structure or function of the load can be estimated. The “load” targeted for measurement and estimation in this study consisted of the water-bearing tissues of the human calf. It was proposed and verified that by measuring the electrical impedance of the human calf and fitting this data to a model of fluid compartments, the lumped-model volume of intracellular and extracellular spaces could be estimated. By performing this estimation over time, the volume dynamics during application of stimuli which affect the direction of gravity can be viewed. The resulting data can form a basis for further modeling and verification of cardiovascular and compartmental modeling of fluid reactions to microgravity as well as countermeasures to the headward shift of fluid during head-down tilt or spaceflight.

TM—2000–210252 May 2000

Mechanical property characterization was performed on AS4/3501–6 graphite/epoxy and SC350G syntactic foam for the SRB Composite Nose Cap Shuttle Upgrades Project. Lamina level properties for the graphite/epoxy were determined at room temperature, 240 °F, 350 °F, 480 °F, 600 °F, and 350 °F after a cycle to 600 °F. Graphite/epoxy samples were moisture conditioned prior to testing. The syntactic foam material was tested at room temperature, 350 °F and 480 °F. A high-temperature test facility was developed at MSFC. Testing was performed with quartz lamp heaters and high resistance heater strips. The thermal history profile of the nose cap was simulated in order to test materials at various times during launch. A correlation study was performed with Southern Research Institute to confirm the test methodology and validity of test results. A-basis allowables were generated from the results of testing on three lots of material.

TM—2000–210279 May 2000

This report presents Mars Global Reference Atmospheric Model 2000 Version (Mars-GRAM 2000) and its new features. All parameterizations for temperature, pressure, density, and winds versus height, latitude, longitude, time of day, and Ls have been replaced by input data tables from NASA Ames Mars General Circulation Model (MGCM) for the surface through 80-km altitude and the University of Arizona Mars Thermosphere General Circulation Model (MTGCM) for 80 to 170 km. A modified Stewart thermospheric model
is still used for higher altitudes and for dependence on solar activity. "Climate factors" to tune for agreement with GCM data are no longer needed. Adjustment of exospheric temperature is still an option. Consistent with observations from Mars Global Surveyor, a new longitude-dependent wave model is included with user input to specify waves having 1 to 3 wavelengths around the planet. A simplified perturbation model has been substituted for the earlier one. An input switch allows users to select either East or West longitude positive. 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—2000–210331 June 2000
Loads Combination Research at Marshall Space Flight Center. R. Ferebee. Structures, Mechanics, and Thermal Department. 20000068925N

This is the result of a study conducted by the Structural Dynamics Division of the Marshall Space Flight Center concerning the combination of low- and high-frequency dynamic loads for spacecraft design. Low-frequency transient loads are combined with high frequency acoustically induced loads to arrive at a limit load, for design purposes. Different methods are used for combining the loads which can lead to considerable variation in limit loads, depending on which NASA Center did the calculation. This study investigates several different combination methods and compares the combination methods with Spacelab 1 flight data. In addition, the relative timing of low- and high-frequency loads is examined.

TM—2000–210384 June 2000
Application of Rapid Prototyping to the Investment Casting of Test Hardware (MSFC Center Director’s Discretionary Fund Final Report, Project No. 98–08). K.G. Cooper and D. Wells. Materials, Processes, and Manufacturing Department.

Investment casting masters of a selected propulsion hardware component, a fuel pump housing, were rapid prototyped on the several processes in-house, along with the new Z-Corp process acquired through this project. Also, tensile samples were prototyped and cast using the same significant parameters. The models were then shelled in-house using a commercial grade zircon-based slurry and stucco technique. Next the shelled models were fired and cast by our in-house foundry contractor (IITRI), with NASA–23, a commonly used test hardware metal. The cast models are compared by their surface finish and overall appearance (i.e., the occurrence of pitting, warping, etc.), as well as dimensional accuracy.


This document lists the significant publications and presentations of the Science Directorate during the period January 1–December 31, 1999. 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). 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 section under Open Literature. Questions or requests for additional information about the entries in this report should be directed to M. Franklin Rose (SD01: (256) 544–7721) or to one of the authors.

TM—2000–210482 September 2000

As part of NASA’s focused technology programs for future reusable launch vehicles, a task is underway to study the feasibility of using the polymer matrix composite feedlines instead of metal ones on propulsion systems. This is desirable to reduce weight and manufacturing costs. The task consists of comparing several prototype composite feedlines made by various methods. These methods are electron-beam curing, standard hand lay-up and autoclave cure, solvent assisted resin transfer molding, and thermoplastic tape laying. One of the critical technology drivers for composite
components is resistance to foreign objects damage. This paper presents results of an experimental study of the damage resistance of the candidate materials that the prototype feedlines are manufactured from. The materials examined all have a 5-harness weave of IM7 as the fiber constituent (except for the thermoplastic, which is unidirectional tape laid up in a bidirectional configuration). The resins tested were 977–6, PR 520, SE–SA–1, RS–E3 (e-beam curable), Cycom 823 and PEEK. The results showed that the 977–6 and PEEK were the most damage resistant in all tested cases.

TM—2000–210558 August 2000

Rapid prototyping (RP) is a layer-by-layer-based additive manufacturing process for constructing three-dimensional representations of a computer design from a wax, plastic, or similar material. Wire arc spray (WAS) is a metal spray forming technique, which deposits thin layers of metal onto a substrate or pattern. Marshall Space Flight Center currently has both capabilities in-house, and this project proposed merging the two processes into an innovative manufacturing technique, in which intermediate injection molding tool halves were to be fabricated with RP and WAS metal forming.
The effects that solar proton events have on microelectronics and solar arrays are important considerations for spacecraft in geostationary and polar orbits and for interplanetary missions. Designers of spacecraft and mission planners are required to assess the performance of microelectronic systems under a variety of conditions. A number of useful approaches exist for predicting information about solar proton event fluences and, to a lesser extent, peak fluxes. This includes the cumulative fluence over the course of a mission, the fluence of a worst-case event during a mission, the frequency distribution of event fluences, and the frequency distribution of large peak fluxes.

Naval Research Laboratory (NRL) and NASA Goddard Space Flight Center, under the sponsorship of NASA’s Space Environments and Effects (SEE) Program, have developed a new model for predicting cumulative solar proton fluences and worst-case solar proton events as functions of mission duration and user confidence level. This model is called the Emission of Solar Protons (ESP) model.
seventh test resulted in elimination of combustion instability with the installation of an orifice immediately upstream of the injector. Formulation and implementation of the model are the scope of this presentation.

The current model is an independent continuation of modeling presented previously by joint Thiokol-Rocketdyne collaborators Boardman, Hawkins, Wassom, and Claflin. The previous model simulated an unstable independent research and development (IR&D) hybrid motor test performed by Thiokol. There was very good agreement between the model and test data. Like the previous model, the current model was developed using Matrix-x simulation software. However, tests performed at MSFC under the HPTLVB program were actually simulated.

In the current model, the hybrid motor, consisting of the liquid oxygen (lox) injector, the multiport solid fuel grain, and nozzle, was simulated. The lox feedsystem, consisting of the tank, venturi, valve, and feed lines, was also simulated in the model. All components of the hybrid motor and lox feedsystem are treated by a lumped-parameter approach.

Agreement between the results of the transient model and actual test data was very good. This agreement between simulated and actual test data indicated that the combustion instability in the hybrid motor was due to two causes: 1. A lox feedsystem of insufficient stiffness, and 2. A lox injector with an impedance or pressure drop that was too low to provide damping against the feedsystem oscillations. Also, it was discovered that testing with a new grain of solid fuel sustained the combustion instability. However, testing with a used grain of solid fuel caused the combustion instability to gradually decay.

TP—2000–209960
20000032093N

Today, El Niño refers to the extreme warming episodes of the globally effective, coupled ocean-atmospheric interaction commonly known as ENSO (i.e., “El Niño-Southern Oscillation”). Concerning its observed decadal frequency and severity, El Niño during the 1990’s has often been regarded as being anomalous. Results of analysis reported herein, however, appear to mitigate this belief.

TP—2000–209961
20000032525N

On the basis of sea surface temperature in the El Niño 3.4 region (5° N–5° S., 120°–170° W.) during the interval of 1950–1997, Kevin Trenberth previously has identified some 16 El Niño and 10 La Niña, these 26 events representing the extremes of the quasi-periodic El Niño-Southern Oscillation (ENSO) cycle. Runs testing shows that the duration, recurrence period, and sequencing of these extremes vary randomly. Hence, the decade of the 1990’s, especially for El Niño, is not significantly different from that of previous decadal epochs, at least, on the basis of the frequency of onsets of ENSO extremes. Additionally, the distribution of duration for both El Niño and La Niña looks strikingly bimodal, each consisting of two preferred modes, about 8- and 16-mo long for El Niño and about 9- and 18-mo long for La Niña, as does the distribution of the recurrence period for El Niño, consisting of two preferred modes about 21- and 50-mo long. Scatterplots of the recurrence period versus duration for El Niño are found to be statistically important, displaying preferential associations that link shorter (longer) duration with shorter (longer) recurrence periods. Because the last onset of El Niño occurred in April 1997 and the event was of longer than average duration, onset of the next anticipated El Niño is not expected until February 2000 or later.

TP—2000–210074
20000037784N

High-cycle fatigue-induced failures in turbine and turbopump blades is a pervasive problem. Single-crystal nickel turbine blades are used because of their superior creep, stress rupture, melt resistance, and thermomechanical fatigue capabilities. Single-crystal materials have highly orthotropic properties making the position of the crystal lattice relative to the part geometry a significant and complicating factor. A fatigue failure criterion based on the maximum shear stress amplitude on the 24 octahedral and 6 cube slip systems is presented for single-crystal nickel superalloys (FCC...
crystal). This criterion greatly reduces the scatter in uniaxial fatigue data for PWA 1493 at 1,200 °F in air. Additionally, single-crystal turbine blades used in the Space Shuttle main engine high pressure fuel turbopump/alternate turbopump are modeled using a three-dimensional finite element (FE) model. This model accounts for material orthotrophy and crystal orientation. Fatigue life of the blade tip is computed using FE stress results and the failure criterion that was developed. Stress analysis results in the blade attachment region are also presented. Results demonstrate that control of crystallographic orientation has the potential to significantly increase a component’s resistance to fatigue crack growth without adding additional weight or cost.

TP—2000–210075 March 2000

A four-channel laser transmissometer has been used to probe the soot content of the exhaust plume of the X–34 60k–lb thrust Fastrac rocket engine at NASA’s Marshall Space Flight Center. The transmission measurements were made at an axial location =1.65 nozzle diameters from the exit plane and are interpreted in terms of homogeneous radial zones to yield extinction coefficients from 0.5–8.4 per meter. The corresponding soot mass density, spatially averaged over the plume cross section, is, for Rayleigh particles =0.7 μg cm⁻³, and alternative particle distributions are briefly considered. Absolute plume radiance at the laser wavelength (515 nm) is estimated from the data at =2,200 K equivalent blackbody temperature, and temporal correlations in emission from several spatial locations are noted.

TP—2000–210387 July 2000

The prospects for realizing a magnetohydrodynamic (MHD–) bypass hypersonic airbreathing engine are examined from the standpoint of fundamental thermodynamic feasibility. The MHD-bypass engine, first proposed as part of the Russian AJAX vehicle concept, is based on the idea of redistributing energy between various stages of the propulsion system flow train. The system uses an MHD generator to extract a portion of the aerodynamic heating energy from the inlet and an MHD accelerator to reintroduce this power as kinetic energy in the exhaust stream. In this way, the combustor entrance Mach number can be limited to a specified value even as the flight Mach number increases. Thus, the fuel and air can be efficiently mixed and burned within a practical combustor length, and the flight Mach number operating...
envelope can be extended. In this paper, we quantitatively assess the performance potential and scientific feasibility of MHD-bypass engines using a simplified thermodynamic analysis. This cycle analysis, based on a thermally and calorically perfect gas, incorporates a coupled MHD generator-accelerator system and accounts for aerodynamic losses and thermodynamic process efficiencies in the various engine components. It is found that the flight Mach number range can be significantly extended: however, overall performance is hampered by nonsentropic losses in the MHD devices.

TP—2000–210481 August 2000
Materials, Manufacturing, and Processes Department and *Old Dominion University.

A static test method for modeling low-velocity foreign object impact events to composites would prove to be very beneficial to researchers since much more data can be obtained from a static test than from an impact test. In order to examine if this is feasible, a series of static indentation and low-velocity impact tests were carried out and compared. Square specimens of many sizes and thicknesses were utilized to cover the array of types of low-velocity impact events. Laminates with α/4 stacking sequence were employed since this is by far the most common type of engineering laminate. Three distinct flexural rigidities under two different boundary conditions were tested in order to obtain damage ranging from that due to large deflection to contact stresses and levels in-between to examine if the static indentation-impact comparisons are valid under the spectrum of damage modes that can be experienced. Comparisons between static indentation and low-velocity impact tests were based on the maximum applied transverse load. The dependent parameters examined included dent depth, back surface crack length, delamination area, and to a limited extent, load-deflection behavior. Results showed that no distinct differences could be seen between the static indentation tests and the low-velocity impact tests, indicating that static indentation can be used to represent a low-velocity impact event.
This history covers the period from 1960 until 1990. It traces the history of the Marshall Space Flight Center in Huntsville, Alabama. The authors treat the Center's technological contributions to the Nation's space program. They also review the Center's cultural and institutional history.
The tenth conference on coherent laser radar technology and applications is the latest in a series beginning in 1980 which provides a forum for exchange of information on recent events current status, and future directions of coherent laser radar (or lidar or lader) technology and applications. This conference emphasizes the latest advancement in the coherent laser radar field, including theory, modeling, components, systems, instrumentation, measurements, calibration, data processing techniques, operational uses, and comparisons with other remote sensing technologies.

This document contains the proceedings of the 32nd annual NASA Aerospace Battery Workshop, hosted by the Marshall Space Flight Center on November 16–18, 1999. 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, nickel-cadmium, lithium-ion, and silver-zinc technologies.

The exploration of space has been a successful national priority for decades. We have landed on the Moon, built the Shuttle, and are building the International Space Station. But, we have only just begun to develop the real commercial potential of space. How large is this potential for the broader business community? What are the technology, policy, and business strategies required to harvest real business value from space? How can we as policymakers, investors, researchers, and business leaders ensure that the commercial development of space advances at a pace and breadth that brings the most benefit to the national economy? To address these related questions, NASA and the U.S. Chamber of Commerce cosponsored a 1-day National Forum on the Future Development of Space, held March 16, 1999, in Washington, D.C. at the U.S. Chamber Headquarters. This report documents the key findings from this forum.
CR—1999–209254 October 1999


Investigation Into the Effects of Microsecond Power Line Transients on Line-Connected Capacitors. H–29919D. EMC Compliance. 20000028367N


MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

LACEFIELD, C. Lockheed Martin

AUSTIN, R.E. TD13
RISING, J.J. Lockheed Martin
X–33, Leading the Way to VentureStar™ in this Decade. For presentation at 51st International Astronautical Congress, Rio de Janeiro, Brazil, October 2–6, 2000.

BAILEY, M.D. TD11
BOWER, M.V. UAH
Polar Plate Theory for Orthogonal Anisotropy. For presentation at the 51st International Astronautical Congress, Rio de Janeiro, Brazil, October 2–6, 2000.

BALLARD, R.O. TD51
OLIVE, T. TD51

BANKS, C. Alabama A&M University
YELLESWARAPU, C. Alabama A&M University
SHARMA, A. Alabama A&M University
FRAZIER, D.O. SD47
PENN, B. SD47
ABDELDAYEM, H. SD47
Characterization of a Fabry-Perot-Based Electrooptic Modulator. For presentation at Optical Society of America ILS Conference, Providence, RI, October 23, 2000.

BARRET, C. TD40

BASHINDZHAGYAN, G. Moscow State University
ADAMS, J.H. SD50
CHILINGARIAN, A. Yerevan Physics Institute
DRURY, L. Dublin Institute
EGOROV, N. Russian Research Institute
GOLUBKOV, S. Russian Research Institute
KOROTKOVA, N. Moscow State University
PANASYUK, M. Moscow State University
PODOROZHNYI, D. Moscow State University
ET AL.

BAUER, L.A. FD36

BEDROSSIAN, H. Lockheed Martin
TINKER, M.L. ED21
HIDALGO, H. ED21

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

BERNSTEIN, E.L. ED33
NUNES, A.C., JR. ED33

BERRY, S. Tufts University
HYERS, R.W. SD47
RACZ, L.M. Tufts University
ABEDJIAN, B. Tufts University

BESHEARS, R.D. ED32

BHAIT, B.N. ED33
SHAH, S.
KAUL, R.
SMITHERS, G.A.
WATSON, M.

BHOWMICK, J. 
KOU, Q. 
ANILKUMAR, A.V. 
GRUGEL, R.N. 
WANG, T. 
Vanderbilt University


BLACKWELL, T. 
AMZAJERDIAN, F. 
KESTER, T.J. 
UAH


BLACKWELL, W.C. 
MINOW, J.I. 
EVANS, S.W. 
HARDAGE, D.M. 
SUGGS, R.M. 
Sverdrupt Technology


BLACKWELL, W.C. 
MINOW, J.I. 
WARREN, K. 
SUGGS, R.M. 
O’DELL, S.L. 
SWARTZ, D.A. 
SD50


BLAKESLEE, R.J. 
BAILEY, J. 
KOSHAK, W.J. 
SD60


BONOMETTI, J.A. 
TD40

<table>
<thead>
<tr>
<th>Authors</th>
<th>Paper Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>BONOMETTI, J.A.</td>
<td>TD40</td>
</tr>
<tr>
<td>MORTON, P.J.</td>
<td>TD40</td>
</tr>
<tr>
<td>SCHMIDT, G.R.</td>
<td>TD40</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Authors</th>
<th>Paper Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROWN, T.</td>
<td>TD52</td>
</tr>
<tr>
<td>SMITH, N.</td>
<td>TD52</td>
</tr>
</tbody>
</table>

Reuse of a Cold War Surveillance Drone to Flight Test a NASA Rocket Based Combined Cycle Engine. For presentation at 11th Annual Symposium on Propulsion, Penn State University, PA, November 18–19, 1999.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Paper Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOXWELL, R.</td>
<td>Lockheed Martin</td>
</tr>
<tr>
<td>BROMLEY, G.</td>
<td>Lockheed Martin</td>
</tr>
<tr>
<td>MASON, D.</td>
<td>Lockheed Martin</td>
</tr>
<tr>
<td>CROCKETT, D.</td>
<td>Lockheed Martin</td>
</tr>
<tr>
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<td>Lockheed Martin</td>
</tr>
<tr>
<td>MCNEAL, R. C.</td>
<td>TD15</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Authors</th>
<th>Paper Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROWN, A.M.</td>
<td>ED21</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Authors</th>
<th>Paper Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROWN, K.K.</td>
<td>TD51</td>
</tr>
<tr>
<td>SPARKS, D.</td>
<td>TD51</td>
</tr>
<tr>
<td>WOODCOCK, G.</td>
<td>Space America, Inc.</td>
</tr>
</tbody>
</table>

BURKE, M.W. UAH
JUDGE, R.A. UAH
PUSEY, M.L. SD48

BURKE, M.W. SD48
JUDGE, R.A. SD48
PUSEY, M.L. SD48

CAMPBELL, C.W. JAYA Corporation
KEITH, A.G. AD10

CARDELINO, B.H. Spelman College
MOORE, C.E. SD40
CARDELINO, C.A. Georgia Institute of Technology
FRAZIER, D.O. SD40
BACHMAN, K.J. North Carolina State University

CARRASQUILLO, E.J. SD47
GRIFFIN, M.R. Tech-Masters
HAMDON, M.S. SD47
JOHNSON, M.L. SD47
GRUGEL, R.N. SD47

CARRINGTON, C.K. FD02
FIKES, J. FD02
GERRY, M. FD02
PERKINSON, D. Sverdorp Technology

CARRUTH, M.R., JR. ED31
FERGUSSON, D. Glenn Research Center
SUGGS, R.M. ED31
MCCOLLUM, M. ED31

CARSWELL, W.E. UAH
PALEY, M.S. USRA
FRAZIER, D.O. SD01
NAUMANN, R.J. UAH

CARUSO, S.V. ED36
CLARK-INGRAM, M.A. ED36

CASH, W. SD50
SHIPLEY, A. SD50
OSTERMAN, S. SD50
JOY, M.K. SD50

CASH, W. SD50
SHIPLEY, A. SD50
OSTERMAN, S. SD50
JOY, M.K. SD50

CHAKRABARTI, S. 
SCHMIDT, G.R. 

CHRISTIAN, H.J. 
BLAKESLEE, R.J. 
GOODMAN, S.J. 

CHUA, D. 
PARKS, G.K. 
BRITTNACHER, M. 
GERMANY, G.A. 
SPANN, J.F. 

CISSOM, R.D. 
COBB, B.J. 
RAMAGE, K.S. 

COFFEY, V.N. 
CHANDLER, M.O. 
MOORE, T.E. 
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RICHARDS, P.G. 
LIAO, J.-H. 
CRAVEN, R.D. 

COOK, S.A. 

CRAIG, L. 
JACOBSON, D. 
MOSIER, D. 
NEIN, M. 
PAGE, T. 
REDDING, D. 
SUTHERLIN, S. 
WILKERSON, G. 

CRAWFORD, K. 

CROUCH, M. 
CARSWELL, W.E. 
FARMER, J.T. 
ROSE, F. 
TIDWELL, P. 
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DABNEY, R.W. 
LOMAS, J.J. 
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DELAY, T.K.  

DENNIS, H.J., JR.  
SANDERS, T.  

DILL, C.C.  

DING, R.J.  

DISCHINGER, H.C., JR.  
HAMILTON, G.S.  
WU, H.-I.  
Texas A&M University  
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DONAHUE, B.B.  
PEARSON, J.B.  
Boeing  
TD40  
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DOWNEY, J.P.  

DOWNEY, J.P.  

DOWNEY, J.P.  

DOWNEY, J.P.  

DUNN, M.C.  
Southern University  
ALVES, J.  
Sigmatech  
HUTCHINSON, S.L.  
ED42  

EDWARDS, D.L.  
CARRUTH, M.R.  
VAUGHN, J.A.  
SCHNEIDER, T.A.  
KAMENETZKY, R.R.  
GRAY, P.  
Native American Services  

EDWARDS, D.L.  
FINCKENOR, M.M.  
ED31  
ED31  
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Title</th>
<th>Conference/Citation</th>
</tr>
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<td>Chandler, M.O.</td>
<td>SD50</td>
<td>Measurements With the Chandra Flight Contamination Monitor</td>
<td>For presentation at 45th Annual SPIE Meeting, San Diego, CA, July 30-August 4, 2000.</td>
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ENG, R. SD73
KEGLEY, J. SD73
KEIDEL, J. SD73


ENG, R. SD73
STAHIL, P. SD73
KEIDEL, J. SD73
KEGLEY, J. SD73
GEARY, J.M. UAH


ENGBERG, R.C. ED27
LASSITER, J.O. ED27
MCGEE, J.K. SRS Technologies


ENGELHAUPT, D. UAH
RAMSEY, B.D. SD50
O’DELL, S.L. SD50
JONES, W.D. SD50
RUSSELL, J.K. SD50


ERICKSON, R.J. FD21
MASON, R.K. Hamilton Sundstrand


ESCHER, W.J.D. SAIC
RODDY, J.E. SAIC
HYDE, E.H. TD15


FARMER, R.C. SECA, Inc.
CHENG, G. SECA, Inc.
TRINH, H.P. TD61
TUCKER, P.K. TD61
HUTT, J.J. TD61

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

FERRARO, R. COLTON, M. DEBLONDE, G. JEDLOVEC, G.J. LEE, T.


FINCKENOR, M.M. CLARK-INGRAM, M.A.

FINCKENOR, M.M. KAMENETZKY, R.R. VAUGHN, J.A. MELL, R. DESHPANDE, M.S.

FINGER, M.H. WILSON-HODGE, C.A.

FIORUCCI, T. LAKIN, D.R., II REYNOLDS, T.D.

FISHER, M.F. CHAMPION, R.H., JR.
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FOWLER, S.B.
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FRADY, G. CHRISTENSEN, E.R.
Sverdrup Technology Sverdrup Technology

FORD, R.L. COLE, S.T. DIFFEY, W.M. GAMBLE, L.J. KEYS, A.S.

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Sverdrup Technology Sverdrup Technology

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FORSYTHE, E. PUSEY, M.L.

FOWLER, S.B.
Flutter Analysis of the X–33. For presentation at 41st AIAA SDM Conference, Atlanta, GA, April 3–6, 2000.
HARRIS, D. ED21
PARKS, R. ED73
BRUNTY, J. ED21

FRAZIER, D.O. SD40

GALLAGHER, D.L. SD50
BILITZA, D.

GALLAGHER, D.L. SD50
MOORE, J.

GALLAGHER, D.L. SD50
OBER, D.

GALLAGHER, D.L. SD50
SANDEL, B.R.

GAMBRELL, S. ASRI
STEPHENSON, A. DA01
The Impact of NASA's Technology at the State and Local Government Level. For presentation at the Council of State Governments, Quebec City, Canada, December 4, 1999.

GARCIA, R. TD63

GENGE, G.G. TD61
MARSH, M.W. TD61

GERRISH, H. TD40

GHOSH, K.K. NAS/NRC/SD50
RAMSEY, B.D. SD50
SADUN, A.C. University of Colorado
SOUNDARARAJAPERUMAL, S. Indian Institute of Technology
WANG, J.R. Yunnan Observatory

GIBLIN, T.W. SD50
CONNAUGHTON, V.
VAN PARADIJS, J.
PREECE, R.D.
BRIGGS, M.S.
KOULIOUETOU, C.
WIJERS, R.A.
FISHMAN, G.J. SD50

GIBSON, H. ED32
MOORE, C. ED32
THOM, R. ED32

GIBSON, U.J. Dartmouth College
HORRELL, E.E. Dartmouth College
KOU, Y. Dartmouth College
PUSEY, M.L. SD48
GILLIES, D.C. SD47

GILLIES, D.C. SD47
The Current Microgravity Materials Science Program. For presentation at Materials Science Conference, Huntsville, AL, June 8, 2000.

GILLIES, D.C. SD47

GILLIES, D.C. SD47
ENGEL, H.P. SD47

GOODMAN, S.J. SD60
BUECHLER, D.E. GHCC
DRISCOLL, K.T. GHCC
BURGESS, D.W. NOAA/NWS/OSF
MAGSIG, M.A. University of Oklahoma

GOODMAN, S.J. SD60
ENGEL, H.P. UAH
DRISCOLL, K.T. UAH
MCCAUL, E.W. USRA

GRAY, P.A. ED31
EDWARDS, D.L. ED31
CARRUTH, M.R. ED31
CAMPBELL, J.W. ED31

GRIFFIN, L.W. TD64
DORNEY, D.J. Virginia Commonwealth

GRODSINSKY, C.M. Bicron Corp.
WHORTON, M.S. TD55

GOODMAN, S.J. SD60
BUECHLER, D.E. UAH
DRISCOLL, K.T. UAH
BURGESS, D.W. NEXRAD
MAGSIG, M.A. NEXRAD

GRAY, P.A. ED31
EDWARDS, D.L. ED31
CARRUTH, M.R. ED31
CAMPBELL, J.W. ED31

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CAMPBELL, J.W. ED31

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CARRUTH, M.R. ED31
CAMPBELL, J.W. ED31

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DORNEY, D.J. Virginia Commonwealth

GRODSINSKY, C.M. Bicron Corp.
WHORTON, M.S. TD55

GRAY, P.A. ED31
EDWARDS, D.L. ED31
CARRUTH, M.R. ED31
CAMPBELL, J.W. ED31
GRUGEL, R.N. SD47

GRUGEL, R.N. SD47

GRUGEL, R.N. SD47
Novel Materials for Application as Shielding During Extended Space Flights. For presentation at Radiation Shielding Workshop, Berkeley, CA, August 8, 2000.

GRUGEL, R.N. BRUSH, L.N. SD47

GRUGEL, R.N. FEDOSEYEV, A.I. SD47

GRUGEL, R.N. M U Z U R U K, K. SD47

GRUGEL, R.N. WATTS, J. SD47

GUBAREV, M. National Research Council
CISZAK, E. USRA
PONOMAREV, I. X-Ray Optical Systems
JOY, M.K. SD50

GUILLORY, A.R. SD60
JEDLOVEC, G.J. SD60
ATKINSON, R.J. Lockheed Martin
HOOD, R.E. SD60
LA FON T A I N E, F.J. Raytheon ITSS

HADAWAY, J.B. UAH
GEARY, J.M. UAH
REARDON, P. UAH
PETERS, B. UAH
KEIDEL, J. SD74
CHAVEY, G. SD74


HAGopian, J. FD34
MEARS, T. Teledyne Brown Engineering

HAKKILA, J. SD50
HAGLIN, D.J. SD50
PENDLETON, G.N. SD50
MALLOZZI, R.S. SD50
MEEGAN, C.A. SD50
ROIGER, R.J. SD50


HALL, D.K. ED11
KIRKICI, H. ED11/Auburn University
HILLARD, G.B. Glenn Research Center
SCHWEICKART, D. U.S. Air Force
DUNBAR, B.

HAMAKER, J. VS20

HAMALTON, G.S. ED42
HALL, M.L. ED42


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


HAMPTON, R.D. TD55
WHORTON, M.S. TD55


HAMPTON, R.D. TD55
WHORTON, M.S. TD55


HAN, S. Tennessee Tech. University
BAI, D. TD40
SCHMIDT, G.R. TD40


HANSON, J.M. TD54


HARDAGE, D.M. ED03
PEARSON, S.D. ED03


HARMON, B.A. SD50
FISHMAN, G.J. SD50
WILSON, C.A. SD50
PACIESAS, W.S. UAH
ZHANG, S.N. UAH
FINGER, M.H. USRA
KOSHUT, T.M. USRA
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

MCCOLLOUGH, M.L. USRA
ROBINSON, C.R. USRA
RUBIN, B.C. USRA


HARRIS, L. ED23
BARBOKA, J. Alabama A&M University
ROJAS-OVIEDO, R. Alabama A&M University
DENG, Z.T. Alabama A&M University


HATHAWAY, D.H. SD50


HATHAWAY, D.H. SD50
BECK, J.G. Stanford University
BOGART, R.S. Stanford University
BACHMANN, K.T. Birmingham-Southern
KHATRI, G. Birmingham-Southern
PETITTO, J.M. Birmingham-Southern
HAN, S. Tennessee Tech. University
RAYMOND, J. Tennessee Tech. University


HATHAWAY, D.H. SD50
WILSON, R.M. SD50
REICHMANN, E.J. SD50


HAYNES, M.W. AD23


HELLIWELL, J.R. University of Manchester, UK
SNELL, E.H. SD48/NRC
CHAYEN, N.E. Blackett Laboratory
JUDGE, R.A. SD48/NRC
BOGGON, T.J. University of Manchester, UK

PUSEY, M.L. SD48


HENDERSON, A.J., JR. ED36


HENDERSON, A.J., JR. ED36


HIDALGO, H., JR. ED21


HODEL, A.S. TD55


HODGE, A.J. ED34
KAUL, R.K. ED34
MCMAHON, W.M. ED34
REINARTS, T. United Space Alliance


HOLDER, D.W. FD21

PARKER, D. Hamilton Sundstrand


HOLT, J.B. TD64
RUF, J.H. TD64

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MAJUMDAR, A. TD53
STEADMAN, T.  
HEDAYAT, A.  

HOLZAPFEL, W.L. 
CARLSTROM, J.E. 
GREGO, L. 
JOY, M.K.  SD50 
REESE, E.D.  

HOLZAPFEL, W.L. 
CARLSTROM, J.E. 
GREGO, L. 
JOY, M.K.  SD50 
REESE, E.D.  
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GUILLOERY, A.R.  SD60 
LAFONTAINE, F.J.  Raytheon ITSS 

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HORACK, J.M.  SD01 
BORCHELT, R.E.  SD01 
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VAN DYKE, M.
GODFROY, T.
MARTIN, J.J.
DICKENS, R.
PEDERSON, K.
POSTON, D.
REID, B.
LIPINSKI, R.
ET AL.


HOUTS, M.
VAN DYKE, M.
GODFROY, T.
PEDERSEN, K.
MARTIN, J.J.
DICKENS, R.
SALVAIL, P.
HRBUD, I.


HOWARD, R.T.
BRYAN, T.C.
BOOK, M.L.


Howard, R.T.
Bryan, T.C.
Book, M.L.


HOWELL, L. SD50
WATTS, J. SD50
LEE, J. NRC


HRBUD, I. TD40
ROSE, M.F. SD01
OLESON, S.R. NYMA Inc.
JENKINS, R.M. Auburn University


HUDSON, S.T. Mississippi State University
ZOLADZ, T.F. TD63
GRIFFIN, L.W. TD63


HUEGELE, V. SD73


HUETER, U. TD15


HUETER, U. TD15


HUMPHRIES, W.R., JR. MP01


JAAP, J. FD42
MUERY, K. FD42


HYDE, D.W. TD13
LAKIN, D.R., II ED13
ASQUITH, T.E. ED13


HYDE, E.H. TD15
ESCHER, D.W. SAIC
HECK, M.T. SAIC
RODDY, J.E. SAIC


HYERS, R.W. SD47
JOHNSON, W.L. California Institute of Technology SAVAGE, L. SD47
ROGERS, J.R. SD47


HYERS, R.W. SD47
TRAPAGA, G. MIT
ABEDIAN, B. Tufts University
MATSON, D.M. MIT


HYERS, R.W. SD47
TRAPAGA, G. MIT
ABEDIAN, B. Tufts University
MATSON, D.M. MIT


JACOBSON, D. ED17

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

JOHNSON, C.L. TD15
LEIFER, S. JPL

JOHNSON, D.L. ED44
RAWLINS, M.A. Raytheon

JOHNSON, D.L. ED44
VAUGHAN, W.W. UAH

JOHNSTON, N.J. LaRC
CLINTON, R.G., JR. ED34
MCMAHON, W.M. ED34

JONES, C.S., III ED32
ADAMS, G. Lockheed Martin
COLLIGAN, K. Lockheed Martin

JONES, M.R. University of Arizona
FARMER, J.T. ED25
BREEDING, S.P. Tech-Masters

JONES, W.D. SD70
O’DELL, S.L. SD50

JOY, M.K. SD50

KAVAYA, M.J. SD60


KENNEDY, P.A. ED18
SIMS, H. ED18


KHAZANOV, G.V. University of Alaska, Fairbanks
STONE, N.H. SD50
KRIVORUTSKY, E.N. University of Alaska, Fairbanks
LIEMOHN, M.W. University of Michigan


KHINE, Y.Y.
WALKER, J.S.
SZOFRAN, F.R. SD47


KIM, C. Chonbuk National University
BOLLER, T. Max-Planck Institute
GHOSH, K.K. NRC
SWARTZ, D.A. USRA
RAMSEY, B.D. SD50


KIM, S. Hoseo University, Korea
GRUGEL, R.N. SD47


KNOX, J.C. FD21


KOCZOR, R.J. SD01

PHILLIPS, T.


KOLODZIEJCZAK, J.J. SD50
ELSNER, R.F. SD50
AUSTIN, R.A. O'DELL, S.L. SD50


KOMAR, D.R. TD53
MCDONALD, J. Sverdrup Technology

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KOSHAK, W.J. SD60

SOLAKIEWICZ, R.J. Chicago State University


LAFONTAINE, F.J. Raytheon ITSS
HOOD, R.E. SD60
GUILLORY, A.R. SD60


LAMB, D.J. SD72


LANSING, M.D. UAH
WALKER, J.L. ED32
RUSSELL, S.S. ED32

<table>
<thead>
<tr>
<th>Author(s)</th>
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<tbody>
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<td>LAPENTA, W.M. SD60</td>
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</tbody>
</table>
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)


LITCHFORD, R.J. TD40
ROBERTSON, T. TD40
HAWK, C.W. UAH
TURNER, M. UAH
KOELFGEN, S. UAH


LONDON, J.R., III TD14

LU, H.-I. USRA
ROBERTSON, F.R. SD60


LUVALL, J.C. SD60
KAY, J.J. University of Waterloo
FRASER, R.F. University of Waterloo


LUVALL, J.C. SD60
KAY, J.J. University of Waterloo
FRASER, R.F. University of Waterloo


LUVALL, J.C. SD60
RICKMAN, D.L. SD60

The Use of Thermal Remote Sensing to Study Thermodynamics of Ecosystem Development. For presentation at Workshop on Multi/Hyperspectral Sensors, Measurements, Modeling, and Simulation, Redstone Arsenal, AL, November 7–9, 2000.

LYLES, G.M. TD15


LYLES, G.M. TD15

Advances in Space Transportation Technology Toward the NASA Goals. For presentation at 51st International Astronautical Congress, Rio de Janeiro, Brazil, October 2–6, 2000.

MACLEOD, T.C. SD22
HO, F.D. UAH


MAJUMDAR, A. ED25
POLSGROVE, R. ED25
TILLER, B. ED25


MALIZIA, A. SD50
BASSANI, L. SD50
DEAN, A.J. SD50
MCCOLLOUGH, M.L. SD50
STEPHEN, J.B. SD50
ZHANG, S.N. SD50


MALONE, C.C. USRA
KARR, L. SD48


MALONE, C.C. SD48
SUMIDA, J. SD48
PUSEY, M.L. SD48

MARTIN, J.J. TD40
HOLT, J.B. TD40

MAZURUK, K. SD47

MAZURUK, K. GD47
GRUGEL, R.N. GD47

MCCLURE, J.C. University of Texas
EVANS, D.M. University of Texas
TANG, W. University of Texas
NUNES, A.C., JR. ED33

MCCOLLOUGH, M.L. USRA/SD50
FISHMAN, G.I. SD50
WALTMAN, E.B. Naval Research Lab

MCCOLLOUGH, M.L. USRA/SD50
WILSON, C.A. SD50

MCCOLLOUGH, M.L. USRA/SD50
WILSON, C.A. SD50
SUN, X. UAH

MCGHEE, D.S. ED21

MCGILL, P. ED33

MCGILL, P. ED33

MCGILL, P. ED33
RUSSELL, S.S. ED32

MCNEAL, C.I., JR. TD15
ANDERSON, W.E. Orbital Sciences Corp.

MEEGAN, C.A. SD50

MEEGAN, C.A. SD50

MENDE, S.B.
HEETDERKS, H.
FREY, H.U.
LAMPTON, M.
gELLER, S.P.
SPANN, J.F.
DOUGANI, H.
FUSELIER, S.A.
MURPHREE, S.
ET AL.
University of CA, Berkeley
University of CA, Berkeley
University of CA, Berkeley
University of CA, Berkeley
Tala Advanced App.
Lockheed Martin
University of Calgary

MENDE, S.B.
HEETDERKS, H.
FREY, H.U.
LAMPTON, M.
University of CA, Berkeley
University of CA, Berkeley
University of CA, Berkeley
University of CA, Berkeley


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X-33, Stepping Stone to Low Cost Access to Space. For presentation at International Space University, Valparaiso, Chile, Summer Session 2000.


NEGUERUELA, I. SAX SDC (Italy) Detection of X-Ray Pulsations From the Be/X-Ray Transient A 0535+26 During a Disc Loss Phase of the Primary. For publication in Astronomy & Astrophysics, Heidelberg, Germany, 1999/2000.

REIG, P. University of Crete
FINGER, M.H. SD50
ROCHE, E University of Leicester

Detection of X-Ray Pulsations From the Be/X-Ray Transient A 0535+26 During a Disc Loss Phase of the Primary. For publication in Astronomy & Astrophysics, Heidelberg, Germany, 1999/2000.

NEWTON, E.K. SD50
GIBLIN, T.W. SD50

NEWTON, E.K. SD50
GIBLIN, T.W. UAH
METCALF, T.


NUNES, A.C., JR. ED33

NUNES, A.C., JR. ED33

NUNES, A.C., JR. ED33

NUNES, A.C., JR. ED33
COAN, B. ED33

KOLODZIEJCZAK, J.J. SD50
MINOW, J.I.


O’DELL, S.L. SD50
JONES, W.D. SD70
SMITH, W.S. SD50
RAMSEY, B.D. SD50

Development of Constellation-X Optics Technologies at MSFC. For presentation at Astronomical Telescopes and Instrumentation, Munich, Germany, March 27–31, 2000.

O’DELL, S.L. SD50
JONES, W.D. SD70
SMITH, W.S. SD50
ENGELHAUPT, D. UAH


OGLESBY, R.
MARSHALL, S.
ROADS, J.


O’NEILL, M.J. ENTECH, Inc.
MCBDANAL, A.J. ENTECH, Inc.
PISZCZOR, M.F. Glenn Research Center
ESKENASI, M.I. AEC-ABLE
JONES, P.A. AEC-ABLE
CARRINGTON, C.K. FD02
EDWARDS, D.L. ED31


ONG, J. Stottler Henke Assoc.
NONEMAN, S.


Fastrac Nozzle Design, Performance and Development.

POLITES, M.E. ED10

PORTER, J.G. SD50
DAVIS, J.M. SD50
GARY, G.A. SD50
WEST, E.A. SD50
RABIN, D.M. NOAO/NSO
THOMAS, R.J. GSFC
DAVILIA, J.M. GSFC

PUSEY, M.L. SD48
BURKE, M.W. UAH
JUDGE, R.A. UAH

PUSEY, M.L. SD48
SNELL, E.H. SD48
JUDGE, R.A. SD48
CHAYEN, N.E. Imperial College, UK
BOGGON, T.J. Univ. of Manchester, UK
HELLIWELL, J.R. Univ. of Manchester, UK

PUSEY, M.L. SD48
SUMIDA, J. USRA

QUATTROCHI, D.A. SD60
LUVALL, J.C. SD60
ESTES, M.G., JR. SD60
LAYMON, C.A. USRA
HOWELL, B.F. USRA

QUAST, P. TRW
TUNG, F. TRW

SUMIDA, J. SD48
Fluorescence Studies of Protein Crystal Nucleation. For presentation at SPIE Conference, San Diego, CA, August 1, 2000.

WIDNER, J. TRW
WEST, M. TD55
RICKMAN, D.L. SD60
ESTES, M.G., JR. USRA
LAYMON, C.A. USRA
HOWELL, B.F. USRA

RAKOCZY, J. SD71
MONTGOMERY, E.E. SD71
LINDER, J. SD71
Recent Enhancements of the Phased Array Mirror Extendible Large Aperture (PAMELA) Telescope Testbed at MSFC. For presentation at Astronomical Telescopes and Instrumentation Conference, Munich, Germany, March 27–31, 2000.

RAMACHANDRAN, N. USRA/SD47
LESLIE, F.W. SD47
Magnetic Susceptibility Effects and Lorentz Damping in Diamagnetic Fluids. For presentation at ITAM Conference, Chicago, IL, August 27-29, 2000.

RAMACHANDRAN, N. USRA/SD47
MAZURUK, K. USRA/SD47
VOLZ, M.P. SD47

RAMACHANDRAN, N. USRA/SD47
YEH, Y.P. Cray Research
SMITH, A.W. SD47
HEAMAN, J.P. SD47

RAKOCZY, J. SD71
MONTGOMERY, E.E. SD71
LINDER, J. SD71
Recent Enhancements of the Phased Array Mirror Extendible Large Aperture (PAMELA) Telescope Testbed at MSFC. For presentation at Astronomical Telescopes and Instrumentation Conference, Munich, Germany, March 27–31, 2000.

RAMSEY, B.D. SD50
O'DELL, S.L. SD50
JONES, W.D. SD50
SMITH, W.S. SD50
ENGELHAUPT, D. SD50
Development of Constellation-X Optics Technologies at MSFC. For presentation at Yamagata University, Kojirakawa, Yamagata, Japan, February 13–22, 2000.

RAWLINS, M.A. Raytheon
JOHNSON, D.L. ED44
BATTTS, G.W. Computer Sciences Corp.

RAY, C.D. FD21
PERRY, J.L. ION Corporation

REESE, E.D. SD50
MOHR, J.J. SD50
CARLSTROM, J.E. SD50
JOY, M.K. SD50
GREGO, L. SD50
HOLDER, G.P. SD50
HOLZAPFEL, W.L. SD50
HUGHES, J.P. SD50
PATEL, S.K. SD50
SMITH, S. SD74
ENG, R. SD74
STAHL, P. SD74
Multi-Use Space Optics Test Facility. For presentation at OSA Optical Meeting, Quebec, Canada, June 18–23, 2000.

REUTER, J.L. FD21

RICKMAN, D.L. SD60
LUVALL, J.C. SD60
WERSINGER, J.M. Auburn University
MASK, P. Auburn University
KISSEL, D.E. University of Georgia
The Design of a Remote Sensing Data Acquisition Campaign for Precision Agriculture and Some Early Results. For presentation at 1999 National Sensing Application Conference and Workshop, Auburn, AL, November 15–17, 1999.

RICKMAN, D.L. SD60
SCHILLER, S. SD60
LUVALL, J.C. SD60

RICKMAN, D.L. SD60
LUVALL, J.C. SD60
SCHILLER, S. South Dakota State Univ.
An Algorithm to Atmospherically Correct Visible and Thermal Airborne Imagery. For presentation at Workshop in Multi/Hyperspectral Sensors, Measurements, Modeling, and Simulation, Redstone Arsenal, AL, November 7–9, 2000.

RITTER, J.M. SD71
Replication of Low Density Electroformed Normal Incidence Optics. For presentation at Diffractive Optics and Micro-Optics/Optical Fabrication & Testing Topical Meeting, Quebec City, Canada, June 18–22, 2000.

RITTER, J.M. SD71
VOSS, K.J. University of Miami

ROADS, J. Scripps Institution of Oceanography
ROBERTSON, F.R. Purdue University
MARSHALL, S. University of North Carolina

ROARK, W. Mevatec
COCKRELL, D. SD46
COKER, C. SD46
BAUGHER, C. SD46

ROBERTS, B.C. ED44
LEAHY, F. Raytheon

ROGACKI, J.R. TD01

ROGERS, J.R. SD47
HYERS, R.W. SD47
ROBINSON, M.B. SD47
SAVAGE, L. SD47

ROGERS, J.R. SD47
HYERS, R.W. SD47
RATHZ, T. SD47
SAVAGE, L. SD47
ROBINSON, M.B. SD47
ROGERS, J.R. SD47
HYERS, R.W. SD47
RATHZ, T.J. SD47
SAVAGE, L. SD47
ROBINSON, M.B. SD47

ROGERS, J.R. SD47
HYERS, R.W. SD47
SAVAGE, L. SD47
ROBINSON, M.B. SD47
RATHZ, T.J. University of Alabama

ROGERS, J.R. SD47
ROBINSON, M.B. SD47
HYERS, R.W. SD47
SAVAGE, L. SD47
RATHZ, T.J. UAH

ROMAN, J. ED25

ROMAN, M.C. FD21

ROSS, R. TD64
MORGAN, D. Lockheed Martin
CROCKETT, D. Lockheed Martin
MARTINEZ, L. Lockheed Martin
ANDERSON, W.E. TD15
MCNEAL, C. TD15

ROTHERMEL, J. SD60
CUTTEN, D.R. UAH
HOWELL, J.N. NOAA
DARBY, L.S. NOAA
HARDESTY, R.M. NOAA
TRATT, D.M. JPL
MENZIES, R.T. JPL

ROZANOV, A.Y. Russian Academy of Science
HOOVER, R.B. SD50

ROZANOV, A.Y. Russian Academy of Science
HOOVER, R.B. SD50

RUF, J.H. TD64

RUSSELL, C. ED33
BJORKMAN, G. Lockheed Martin

RUSSELL, S.S. ED32
LANSING, M.D. UAH
WALKER, J.L. ED32

RUSSELL, S.S. ED32
WALKER, J.L. ED32
LANSING, M.D. ED32

SACKHEIM, R.L. DA01
Transportation—the Key to Unlocking the Final Frontier. For presentation at NASA Reusable Launch Vehicle Exposition, Dryden Flight Research Center, CA, June 22, 2000.

SACKHEIM, R.L. DA01

SACKHEIM, R.L. DA01
HOUTS, M. DOE

SAFIE, F.M. QS10
BELYEU, R.L. Hernandez Engineering

SAMIR, U. Tel Aviv University, Israel
ISRAELEVICH, P. Tel Aviv University, Israel
WRIGHT, K.H., JR. UAH
STONE, N.H. SD50

SCHALLHORN, P. Sverdrup Technology
PALMITER, C. Sverdrup Technology
FARMER, J.T. ED25
LYCANS, R. Sverdrup Technology
TILLER, B. ED25

SCHLAGHECK, R.A. SD44
TRACH, B. Boeing

SCHLAGHECK, R.A. SD44
TRACH, B. Boeing
Microgravity Research Results and Experiences from the NASA MIR Space Station Program. For presentation at 51st International Astronautical Congress, Rio de Janeiro, Brazil, October 2–6, 2000.

SCHMIDT, G.R. TD40
BONOMETTI, J.A. TD40
MORTON, P.J. TD40

SCHNEIDER, T.A. ED31
VAUGHN, J.A. ED31
CARRUTH, M.R., JR. ED31
EDWARDS, D.L. ED31
HEARD, J.W. ED31
SCHORR, A.A. MP51
ENDICOTT, J.B.

SCHROCK, K. ED18
FREESTONE, T. ED18
BELL, L. ED18

SCHUNK, R.G. ED26
CHUNG, T.J. UAH

SCHUNK, R.G. ED26
BELL, L. ED18

SCHUNK, R.G. ED26
CHUNG, T.J. UAH

SCHWARTZ, D.A. Smithsonian
DAVID, L.P. Smithsonian
DONNELLY, R.H. Smithsonian
DEWEY, D. MIT
MARSHALL, H.L. MIT
ELSNER, R.F. SD50
KOLODZIEJCZAK, J.J. SD50
O'DELL, S.L. SD50
TENNANT, A.F. SD50
ET AL.

SELLERS, C.C. University of Illinois
WALKER, J.S. University of Illinois
SZOFRAN, F.R. SD47
MOTAKEF, S. Cape Simulations, Inc.

SEVER, T.L. SD60

SEYBERT, C.D. University of CA, Berkeley
EVANS, J.W. University of California
LESLEI, F.W. SD47
JONES, W.K., JR. Motorola

SEYBERT, C.D. University of CA, Berkeley
EVANS, J.W. University of California
LESLEI, F.W. SD47
JONES, W.K., JR. Motorola
Exploiting the Temperature Dependence of Magnetic Susceptibility to Control Convection in Fundamental Studies of Solidification Phenomena. For presentation at Microgravity Materials Science Conference, Huntsville, AL, June 7, 2000.

SEYBERT, C.D. University of CA, Berkeley
EVANS, J.W. University of California
LESLEI, F.W. SD47
JONES, W.K., JR. Motorola

SHAW, E.J. VS20

SHIPLEY, A. SD50
CASH, W. SD50
JOY, J. SD50

SHKOLNIKOV, I. UAH
SHTESSEL, Y. UAH
WHORTON, M.S. TD55
JACKSON, M. TD55

SHTESSEL, Y.B. UAH
HALL, C.E. TD55

SHTESSEL, Y.B. UAH
HALL, C.E. TD55
JACKSON, M. TD55

SHULAR, D.A. ED25
SMITHERS, G.A. ED24
PLAWSKY, J.L. Rensselaer Polytechnic

SHYY, W. University of Florida
PAPILA, N. University of Florida

TUCKER, K. TD64
VAIDYANATHAN, R. University of Florida
GRiffin, L.W. TD64

SIMPSON, J. GSFC
KUMMEROW, C.D.
MENEGHINI, R.
HOU, A.
ADLER, R.F.
HUFFMAN, G.
BARKSTROM, B.
WIELICKI, B.
GOODMAN, S.J. SD60

SIMS, W.H. ED18

SINGER, J. MP01

SIPIERA, P.P. Harper College
HOOVER, R.B. SD50

SKETOE, J.G. Boeing
CLARK, A. ED44

SKOFRONICK-JACKSON, G.M.
WANG, J.R.
HEYMSFIELD, G.M.
HOOD, R.E. SD60

SLADE, K.N. Duke University
TINKER, M.L. ED21
LASSITER, J.O. ED27
ENGBERG, R.C. ED27

SMITHERMAN, D.V., JR. FD02

SOHN, B.-J. Seoul National University
ROBERTSON, F.R. SD60
SMITH, E.A. SD60
PARK, S.-C. Seoul National University

SPANN, J.F. SD50
ABBAS, M.M. SD50
SUSS, S.T. SD50
VENTURINI, C.C. UAH
COMFORT, R.H. UAH

SPANN, J.F. SD50
ABBAS, M.M. SD50
VENTURINI, C.C. UAH

SPANN, J.F. SD50
ABBAS, M.M. SD50

VENTURINI, C.C. SD50
COMFORT, R.H. SD50

SPANN, J.F. SD50
VENTURINI, C.C. UAH
ABBAS, M.M. SD50
COMFORT, R.H. UAH

SPEEGLE, C.O. Raytheon ITSS
RAMSEY, B.D. SD50
ENGELHAUPT, D. UAH

SPENCER, R.W. SD60
Global Climate Monitoring with the EOS PM-Platform's Advanced Microwave Scanning Radiometer (AMSR-E). For presentation at 80th AMS Annual Meeting on Satellite Meteorology and Oceanography, Long Beach, CA, January 9-14, 2000.

SPRINGER, A.M. TD14

STANLEY, T.T. International Space Systems, Inc.
ALEXANDER, R.A. TD31
LANDRUM, B. UAH

STEFANESCU, D.M. University of Alabama
CATALINA, A.V. SD47
JURETZKO, F.R. University of Alabama
MUKHERJEE, S. University of Alabama
SEN, S. SD47/USRA
Particle Engulfment and Pushing Microgravity Experiments and Mathematical Modeling. For presentation at First International Symposium on

STEFANESCU, D.M. University of Alabama
MUKHERJEE, S. University of Alabama
JURETZKO, F.R. University of Alabama
CATALINA, A.V. USRA
SEN, S. USRA
CURRERI, P.A. SD47


STERLING, A.C. SD50

STERLING, A.C. SD50
Sigmoid CME Source Regions at the Sun: Some Recent Results. For publication in Journal of Atmospheric and Solar-Terrestrial Physics, 2000.

STERLING, A.C. SD50
MOORE, R.L. SD50

SU, C.-H. SD47
BREBRECK, R.F. Marquette University
BURGER, A. Fisk University
DUDLEY, M. State U of New York
MAY, R.J. University of Wisconsin
RAMACHANDRAN, N. USAR
SHA, Y.-G. USRA
VOLZ, M.P. SD47
SHIH, H.-D. Central Research Labs


SU, C.-H. SD47
FETH, S. UAH
LEHOCZY, S.L. SD47
MOORE, T.E. GSFC
GILES, B.L. GSFC

PARKS, G.K. Univ. of Washington, Seattle

SU, Y.U. Los Alamos National Lab


SU, C.-H. SD47
SU, Y.U. SD47
MOORE, T.E. GSFC
GILES, B.L. GSFC


SUESS, S.T. SD50
POLETTO, G. SD50

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
<th>Conference/Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLETTO, G.</td>
<td>SD50</td>
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<td>ROMOLI, M.</td>
<td>JPL</td>
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<td>NEUGEBAUER, M.</td>
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<td>GOLDSTEIN, B.E.</td>
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<td>SIMNETT, G.</td>
<td>U of Birmingham, UK</td>
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<td>SUESS, S.T.</td>
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<td>SUMIDA, J.</td>
<td>USRA</td>
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<td>FORSYTHE, E.</td>
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<td>SUMRALL, J.</td>
<td>NASA Headquarters</td>
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<td>SWANSON, G.R.</td>
<td>ED22</td>
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<td>SWARTZ, D.A.</td>
<td>SD50</td>
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<td>CHEN, Y.</td>
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<tr>
<td>RAMSEY, B.D.</td>
<td>SD50</td>
<td>Background Simulation for the MSFC GSPC Balloon Payload. For presentation at 45th Annual SPIE Meeting, San Diego, CA, July 30–August 4, 2000.</td>
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<tr>
<td>SZOFRAN, F.R.</td>
<td>SD47</td>
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<td>BENZ, K.W.</td>
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<td>CROSS, A.</td>
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<td>Albert-Ludwigs University</td>
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<td>KAISER, N.</td>
<td>Albert-Ludwigs University</td>
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<td>MOTAKEF, S.</td>
<td>CAPE Simulations, Inc.</td>
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<td>VOLZ, M.P.</td>
<td>SD47</td>
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<tr>
<td>THOMAS, R.J.</td>
<td>New Mexico Inst. of Mining&amp;Tech.</td>
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<td>KREHBIEL, P.R.</td>
<td>New Mexico Inst. of Mining&amp;Tech.</td>
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<td>RISON, W.</td>
<td>New Mexico Inst. of Mining&amp;Tech.</td>
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<td>New Mexico Inst. of Mining&amp;Tech.</td>
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<td>BOCCIPIPIO, D.J.</td>
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<td>GOODMAN, S.J.</td>
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<td>TIMOFEEVA, T.V.</td>
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<td>ANTIPOP, M.Y.</td>
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<td>PECK, J.</td>
<td>ED21</td>
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<tr>
<td>AYALA, S.</td>
<td>Sverdrup Technology</td>
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</tbody>
</table>

TRINH, H.P. 

TRINH, H.P. 

TROLINGER, J.D. 
RANGEL, R. 
COIMBRA, C. 
LAL, R.B. 
WITHEROW, W.K. 
ROGERS, J.R. 

TROLINGER, J.D. 
RANGEL, R. 
COIMBRA, C. 
WITHEROW, W.K. 
ROGERS, J.R. 

TU, J.-N. 
WU, X.-Y. 
HORWITZ, J.L. 
STEVenson, B.A. 
MOORE, T.E. 
COFFEEY, V.N. 

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PAPILA, N. 
SHYY, W. 
TUCKER, P.K. 
GRIFFIN, L.W. 
HAFTKA, R. 
FITZ-COY, N. 
University of Florida

VAIDYANATHAN, R. 
WALISH, J. 
FOX, M. 
RIGALI, M. 
SUTARIA, M. 
GILLESPIE, J.W., JR. 
YARLAGADDA, S. 
EFFINGER, M.R. 
Advanced Ceramics

TU, J.-N. 
WU, X.-Y. 
HORWITZ, J.L. 
STEVenson, B.A. 
MOORE, T.E. 
COFFEEY, V.N. 
TUCKER, D.S. 
WORKMAN, G.L. 
SMITH, G.A. 


50
VAN DYKE, M. TD40

VAN DYKE, M. TD40
GODFROY, T. TD40
HOUTS, M. TD40
DICKENS, R. TD40
DOBSON, C. TD40
PEDERSON, K. TD40
REID, B. Los Alamos National Lab

VAN DYKE, M. TD40
HOUTS, M. TD40
PEDERSON, K. TD40
GODFROY, T. TD40
DICKENS, R. TD40
POSTON, D. TD40
REID, B. Los Alamos National Lab
SALVAI, R. IIT Research Institute
RING, P. Advanced Methods

VAUGHN, J.A. ED31
FINCKENOR, M.M. ED31
KAMENETZKY, R.R. ED31
SCHULER, P. Triton Systems, Inc.

VAUGHN, J.A. ED31
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SPANN, J.F. SD50
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WITHEROW, W.K. SD48

VIKRAM, C.S. UAH
WITHEROW, W.K. SD48

VIKRAM, C.S. UAH
WITHEROW, W.K. SD48

VIKRAM, C.S. UAH
WITHEROW, K. SD48

VIKRAM, C.S. UAH
WITHEROW, K. SD48

VOLZ, M.P. SD47
MAZURUK, K. SD47

VOLZ, M.P. SD47
MAZURUK, K. SD47

VOLZ, M.P. SD47
MAZURUK, K. SD47
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Institution</th>
<th>Reference/Conference Details</th>
</tr>
</thead>
</table>
WEISSKOPF, M.C. SD50

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ELSNER, R.F.
KAHN, S.
KOLODZIEJCZAK, J.J.
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O’DELL, S.L.
PAERELS, F.
SHIBAZAKI, N.
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ELSNER, R.F. SD50
SCHULZ, N.S. MIT
MARSHALL, H.L. MIT
KAROVSKA, M. Harvard-Smithsonian
NICHOLS, J.S. Harvard-Smithsonian
ET AL.

WEISSKOPF, M.C. SD50
TANANBAUM, H.
SPEYBROECK, L.P.
O’DELL, S.L.

WEISSKOPF, M.C. SD50
TANANBAUM, H.
VAN SPEYBROECK, L.
O’DELL, S.L.

WEST, E.A. SD50
PORTER, J.G. SD50
DAVIS, J. SD50
GARY, A. SD50
SPANN, J.F. SD50

WHITAKER, A.F. ED30

WHITEMAN, D.N.
EVANS, K.D.
DEMOZ, B.
STARR, D.O.
TOBIN, D.
FELTZ, W.
JEDLOVEC, G.J.
GUTMAN, S.I.
SCHWEMMER, G.K.
ET AL.

WHORTON, M.S. TD55
CALISE, A.J. Georgia Institute of Technology

WHORTON, M.S. TD55
MYERS, G.
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

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ROTHKIN, K. SD60
STEVenson, D. SD60
BOCcippio, D.J. SD60

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WILLIAMS, R.W. TD64
SKELLEY, S.E. TD64
STEWART, E.T. TD64
DROEGE, A.R. TD64
PRUEGER, G.H. Boeing
CHEN, W.-C. Boeing
WILLIAMS, M. Boeing


WILSON, C.A. SD50
FINGER, M.H. USRA
SCOTT, D.M. USRA


WILSON, R.M. SD50


WILSON, R.M. SD50


WILSON, R.M. SD50


WILSON-HODGE, C.A. SD50
CHENG, W.-C. Boeing


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FINGER, M.H. USRA
WOODS, P.M. USRA
GOGUS, E. UAH

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WINGARD, C.D. ED34


WINGARD, C.D. ED34


WOODS, P.M. UAH
KOUVELIOTOU, C. USRA/SD50
VAN PARADIJS, J. UAH
KOSHUT, T.M. USRA/SD50
FINGER, M.H. USRA/SD50
BRIGGS, M.S. USRA/SD50
FISHMAN, G.F. SD50
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DONG, P. Battelle Memorial Inst.
ROGERS, P. ED22


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SU, C.-H. SD47
COCHRANE, J.C. USRA/SD47
LEHOCZKY, S.L. SD47
MUNTELE, I. Alabama A&M University
ILA, D. Alabama A&M University


ZHU, S. USRA
SU, C.-H. SD47
LEHOCZKY, S.L. SD47


ZHU, S. USRA
SU, C.-H. SD47
LEHOCZKY, S.L. SD47


ZHU, S. USRA
SU, C.-H. SD47
LEHOCZKY, S.L. SD47


ZHU, S. USRA
SU, C.-H. SD47
LEHOCZKY, S.L. SD47
GEORGE, M.A. UAH


LOWNDES, D.H. Oak Ridge National Lab


ZIMMERMAN, F.R.

ZOLADZ, T.F.
INDEX

TECHNICAL MEMORANDA

Bishop, R. ................................................................. 2
Carter, R.W. .............................................................. 1
Cooper, K.G .............................................................. 5, 6
DeLay, T.K. ................................................................. 3
Dewberry, B .............................................................. 4
Ding, J. ........................................................ ................. 1
Elam, S.K ................................................................. 3
Ferebee, R ................................................................. 5
Fox, D. ........................................................ .................. 2
Fragomeni, J.M ........................................................... 1
Hayashida, K.B ........................................................... 2
Holland, W. ............................................................... 2
Holt, J.B. ........................................................ .......... 3
Humphries, W.R., Sr .................................................. 2
James, B.F. ............................................................... 4
Johnson, D.L. ............................................................ 4
Justus, C.G ............................................................... 4
Lee, J.A. ................................................................. 1, 2
Martin, J.J. ............................................................... 3
Nettles, A.T .............................................................. 5
Newton, R.L ............................................................. 1
Nunes, A.C., Jr .......................................................... 1
Ortega, R ................................................................. 2
Price, J.M ................................................................. 2
Robinson, J.H ........................................................... 2
Russell, C.K ............................................................. 1
Sumners, F.G ........................................................... 5
Sutherland, T ............................................................. 1
Turner Waits, J.E ....................................................... 3
Vaughan, W.W .......................................................... 4
Wells, D ................................................................. 5
Woodard, D ............................................................. 1
Zimmerman, F.R ....................................................... 1

TECHNICAL PUBLICATIONS

Arakere, N.K ............................................................. 8
Barth, J.L ................................................................. 7
Bityurin, V.A ............................................................ 9
Burke, E.A. ............................................................. 7
Christenson, R.L ..................................................... 7
Cole, J.W ................................................................. 9

Dobson, C.C .............................................................. 9
Douglas, M.J ............................................................ 10
Eskridge, R.H ........................................................... 9
Gee, G.B ................................................................. 7
Gerasimenko, L.M .................................................... 7
Hoover, R.B ............................................................. 7
Knight, K.C ............................................................. 7
Lee, M.H ................................................................. 9
Leslie, F ................................................................. 9
Lineberry, J.T ........................................................... 9
Litchford, R.J ........................................................... 9
Nettles, A.T ............................................................ 10
Ragozina, A.L ........................................................... 7
Ramachandran, N ..................................................... 9
Rocker, M ............................................................... 7
Rozanov, A.Y ........................................................... 7
Stassinopoulos, E.G .................................................. 7
Swanson, G.R ........................................................... 8
Ushatinskaya, G.T ..................................................... 7
Whitley, M.R ........................................................... 7
Wilson, R.M ............................................................ 8
Xapsos, M.A ............................................................ 7
Zhegallo, E.A ........................................................... 7

SPECIAL PUBLICATIONS

Dunar, A.J ............................................................... 11
Waring, S.P ............................................................. 11

CONFERENCE PUBLICATIONS

Brewer, J.C ............................................................. 12
Dooling, D ............................................................. 12
Kavaya, M.J ........................................................... 12
Smitherman, D.V., Jr ............................................... 12

CONTRACTOR REPORTS

EMC Compliance ....................................................... 13
University of Illinois ................................................. 13
Science Applications International Corporation .... 13
Space Environments and Effects Program ............ 13
PAPERS CLEARED FOR PRESENTATION

Abbas, M.M. ................................................................. 47, 51
Abeldayem, H. ............................................................ 14, 15
Abedian, B. ................................................................. 15, 31
Abiad, R. ................................................................. 37
Ackerman, E. ............................................................ 17
Adams, G. ................................................................. 32
Adams, J.H. .............................................................. 14, 15, 26
Adams, J.H., Jr. ........................................................ 34, 52
Adams, J.L. ............................................................... 14
Adler, R.F. ................................................................. 46
Alexander, R.A. ......................................................... 14, 47
Altstatt, R.L. .............................................................. 14
Alves, J. ................................................................. 20
Amzajerdian, F. ......................................................... 16
Anderson, D.M. ....................................................... 14
Anderson, W.E. ....................................................... 14, 36, 43
Anfimov, D.S. .......................................................... 37
Anilkumar, A.V. ........................................................ 14, 16
Antipin, M.Y. ............................................................ 49
Arakere, N.K. ........................................................... 14, 49
Askew, R. ................................................................. 37
Asquith, T.E. ............................................................ 31
Atkinson, R.J. ............................................................ 26
Austin, R.A. .............................................................. 33, 41
Austin, R.E. .............................................................. 14, 15
Ayala, S. ................................................................. 49
Bachman, K.J. .......................................................... 18
Bachmann, K.T. ....................................................... 28
Bai, D. .................................................................... 27
Bailey, J. ................................................................. 16
Bailey, M.D. ............................................................ 15
Ballard, R.O. ............................................................ 15
Banker, B.D. ............................................................ 55
Banks, C. ................................................................. 15
Barboka, J. ............................................................... 28
Barkstrom, B. ........................................................... 46
Barret, C. ................................................................. 15
Bashindzhagyan, G. .................................................. 14, 15
Bashindzhagyan, P. .................................................. 14
Bassani, L. ............................................................... 35
Batts, G.W. .............................................................. 41
Bauer, L.A. ............................................................... 15
Baugh, C. ................................................................. 42
Bautz, M. ................................................................. 38
Beck, J.G. ................................................................. 28
Becker, W. ............................................................... 53
Bedrossian, H. ........................................................ 15
Beech, G.S. ............................................................. 15, 27
Bell, L. ................................................................... 45
Bellamy, H. ............................................................. 32
Belyeu, R.L. ............................................................. 44
Benz, K.W. ............................................................. 49
Bernstein, E.L. ......................................................... 15
Bero, E. ................................................................. 14
Berry, S. ................................................................. 15
Beshears, R.D. ......................................................... 15
Beveridge, J. ............................................................ 49
Bhat, B.N. ............................................................... 14
Bhowmick, J. ........................................................... 14, 16
Bilitza, D. ............................................................... 24
Bitteker, L. ............................................................. 29
Bityurin, V.A. .......................................................... 34
Bjorkman, G. ........................................................ 43
Blackwell, T. ........................................................... 16
Blackwell, W.C. ...................................................... 16, 37, 38
Blakeslee, R.J. ........................................................ 16, 19
Blanc, J.D. ............................................................. 16
Boccippio, D.J. ........................................................ 16, 49, 54
Boeck, W. ............................................................. 16
Bogart, R.S. ........................................................... 28
Boggon, T.J. .......................................................... 28, 40
Boller, T. ............................................................... 33
Bonometti, J.A. ....................................................... 16, 17, 29, 44
Book, M.L. ............................................................ 30
Borchelt, R.E. ......................................................... 29
Borgstahl, G.E. ....................................................... 32
Bower, M.V. .......................................................... 15
Boxwell, R. ............................................................ 17
Brainerd, J.J. .......................................................... 17
Brantly, R. ............................................................. 17
Brebrick, R.F. ........................................................ 48
Breeding, S.P. ......................................................... 32
Bridge, K.Y. ........................................................... 55
Briggs, M.S. ........................................................... 17, 24, 37, 54
Brittinacher, M. ...................................................... 19, 23, 39
Bromley, G. ........................................................... 17
Brown, A. ............................................................. 39
Brown, A.M. .......................................................... 17
Brown, K.K. .......................................................... 17
Brown, T. ............................................................. 17
Brunty, J. ............................................................. 24, 39
Brush, L.N. .......................................................... 26
Bryan, T.C. ............................................................ 30
Buechler, D.E. ........................................................ 17, 25
Bune, A.V ................................................................. 17
Burger, A ................................................................. 17, 48
Burgess, D.W ............................................................ 25
Burke, M.W .............................................................. 18, 40
Butler, K ................................................................. 14
But, Y.M ................................................................. 38
Calise, A.J ................................................................. 53
Callahan, D.M .......................................................... 41
Callahan, M.J .......................................................... 56
Cameron, R .............................................................. 38
Campbell, C.W ...................................................... 18
Campbell, J.W .......................................................... 25
Caraccioli, P ............................................................ 52
Cardelino, B.H .......................................................... 18, 49
Cardelino, C.A .......................................................... 18
Carlstrom, J.E ............................................................ 29, 32, 39, 41
Carpenter, P ............................................................ 55
Carrasquillo, E.J ....................................................... 18
Carrington, C.K ....................................................... 18, 38
Carruth, M.R ............................................................ 20, 25
Carruth, M.R., Jr ...................................................... 18, 44
Carruthers, C .......................................................... 17
Carswell, W.E ......................................................... 18, 19
Carter, J ................................................................. 32
Caruso, S.V ............................................................. 18
Cash, W ................................................................. 18, 32, 46
Cassanto, J.M .......................................................... 32
Catalina, A.V .......................................................... 47, 48
Cha, S.S ................................................................. 34
Chakrabarti, S .......................................................... 19
Champion, R.H., Jr ............................................... 23
Chandler, M.O ......................................................... 19, 21, 48
Chang, C.L .............................................................. 55
Chattopadhyay, K .................................................... 17
Chavers, G ............................................................. 27
Chayen, N.E ............................................................ 28, 40
Chen, L ................................................................. 32
Chen, L.J ................................................................. 23
Chen, W.-C ............................................................. 54
Chen, Y ................................................................. 49
Chen, Y.-S ............................................................. 52
Cheng, G ................................................................. 22
Chilingarian, A ......................................................... 14, 15
Christensen, E.R ..................................................... 23
Christian, H.J .......................................................... 16, 17, 19, 49
Chu, T ................................................................. 55
Chua, D ................................................................. 19, 39
Chung, T.J ............................................................. 45
Cissom, R.D ............................................................ 19
Ciszak, E ................................................................. 26
Clark, A ................................................................. 46
Clark, R.D .............................................................. 49
Clark-Ingram, M.A .................................................. 18, 23
Clinton, R.G., Jr ..................................................... 20, 32
Coan, B ................................................................. 38
Cobb, B.J ............................................................... 19
Cobb, S.D .............................................................. 49
Cochrane, J.C .......................................................... 56
Cockrell, D ............................................................ 42
Coffey, V.N ............................................................. 19, 50
Coimbra, C ............................................................. 50
Coker, C ................................................................. 42
Cole, S.T ................................................................. 23
Coleman, H.W ........................................................ 14
Colligan, K ............................................................ 32
Colton, M ............................................................... 23
Comfort, R.H .......................................................... 19, 21, 47, 51
Connaughton, V ..................................................... 24
Cook, S.A ............................................................... 19
Craig, L ................................................................. 19
Cramer, J ............................................................... 16
Craven, P.D ............................................................ 19, 21, 29, 34, 48, 55
Crawford, K .......................................................... 19
Crockett, D ........................................................... 14, 17, 43
Cross, A ................................................................. 49
Crouch, M ............................................................. 19
Cruzen, C.A ............................................................ 19
Cummins, K ........................................................... 16
Curren, P.T .............................................................. 39, 48
Cutten, D.R ............................................................ 43
D’Agostino, M .......................................................... 39
Dabney, R.W .......................................................... 19
Darby, L.S .............................................................. 43
David, L.P ............................................................. 45
Davila, J.M ............................................................. 40
Davis, D ................................................................. 39
Davis, J ................................................................. 53
Davis, J.M .............................................................. 19, 40
Dean, A.J ............................................................... 35
Deblonde, G ............................................................ 23
Delay, T.K .............................................................. 20
Demoz, B .............................................................. 53
Deng, Z.T ............................................................... 28
Dennis, H.J., Jr ....................................................... 20
Dennis, J ................................................................. 20
Denton, R.E ........................................................... 25
<table>
<thead>
<tr>
<th>Name</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deshpande, M.S.</td>
<td>23</td>
</tr>
<tr>
<td>Dewey, D.</td>
<td>45</td>
</tr>
<tr>
<td>Dickens, R.</td>
<td>25, 29, 30, 51</td>
</tr>
<tr>
<td>Diffey, W.M.</td>
<td>23</td>
</tr>
<tr>
<td>Dill, C.C.</td>
<td>20</td>
</tr>
<tr>
<td>Ding, R.J.</td>
<td>20</td>
</tr>
<tr>
<td>Dischinger, H.C., Jr.</td>
<td>20</td>
</tr>
<tr>
<td>Dobson, C.</td>
<td>29, 51, 52</td>
</tr>
<tr>
<td>Dold, P.</td>
<td>49</td>
</tr>
<tr>
<td>Donahue, B.B.</td>
<td>20</td>
</tr>
<tr>
<td>Dong, P.</td>
<td>54</td>
</tr>
<tr>
<td>Donnelly, R.H.</td>
<td>45</td>
</tr>
<tr>
<td>Donovan, D.</td>
<td>22</td>
</tr>
<tr>
<td>Dorney, D.J.</td>
<td>25, 52</td>
</tr>
<tr>
<td>Dougani, H.</td>
<td>36</td>
</tr>
<tr>
<td>Downey, J.P.</td>
<td>20</td>
</tr>
<tr>
<td>Driscoll, K.T.</td>
<td>17, 25</td>
</tr>
<tr>
<td>Drobot, A.</td>
<td>55</td>
</tr>
<tr>
<td>Drooge, A.R.</td>
<td>54</td>
</tr>
<tr>
<td>Drury, L.</td>
<td>14, 15</td>
</tr>
<tr>
<td>Dudley, M.</td>
<td>48</td>
</tr>
<tr>
<td>Dunbar, B.</td>
<td>27</td>
</tr>
<tr>
<td>Dunn, M.C.</td>
<td>20</td>
</tr>
<tr>
<td>Eckel, A.</td>
<td>20, 21</td>
</tr>
<tr>
<td>Edwards, D.L.</td>
<td>14, 20, 25, 38, 44</td>
</tr>
<tr>
<td>Effinger, M.R.</td>
<td>20, 21, 37, 39, 49, 50</td>
</tr>
<tr>
<td>Egorov, N.</td>
<td>14, 15</td>
</tr>
<tr>
<td>Elam, S.</td>
<td>20, 21, 39</td>
</tr>
<tr>
<td>Ellingson, B.</td>
<td>21</td>
</tr>
<tr>
<td>Elliot, H.A.</td>
<td>21</td>
</tr>
<tr>
<td>Elsner, R.F.</td>
<td>21, 33, 38, 41, 45, 53</td>
</tr>
<tr>
<td>Emerson, C.W.</td>
<td>21, 40</td>
</tr>
<tr>
<td>Emrick, W.J., Jr.</td>
<td>21</td>
</tr>
<tr>
<td>Endicott, J.B.</td>
<td>45</td>
</tr>
<tr>
<td>Eng, R.</td>
<td>22, 42</td>
</tr>
<tr>
<td>Engberg, R.C.</td>
<td>22, 47</td>
</tr>
<tr>
<td>Engel, H.P.</td>
<td>25</td>
</tr>
<tr>
<td>Engelhaupt, D.</td>
<td>22, 38, 41, 47</td>
</tr>
<tr>
<td>Erickson, R.J.</td>
<td>22</td>
</tr>
<tr>
<td>Escher, D.W.</td>
<td>31</td>
</tr>
<tr>
<td>Escher, W.J.D.</td>
<td>22</td>
</tr>
<tr>
<td>Eskenasi, M.I.</td>
<td>38</td>
</tr>
<tr>
<td>Eskridge, R.</td>
<td>52</td>
</tr>
<tr>
<td>Estes, M.G., Jr.</td>
<td>40</td>
</tr>
<tr>
<td>Ethridge, E.C.</td>
<td>22</td>
</tr>
<tr>
<td>Evans, D.M.</td>
<td>36</td>
</tr>
<tr>
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<td>Name</td>
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<td>Siler, R.</td>
<td>41</td>
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<td>Simmons, E.</td>
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<td>Simnett, G.</td>
<td>49</td>
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<td>Simpson, J.</td>
<td>46</td>
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<td>Sims, H.</td>
<td>33</td>
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<td>Sims, W.H.</td>
<td>46</td>
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<td>Singer, J.</td>
<td>46</td>
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<td>Singh, N.</td>
<td>34</td>
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<td>Sipiera, P.P.</td>
<td>46</td>
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<td>Sisk, R.C.</td>
<td>39</td>
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<tr>
<td>Skelley, S.E.</td>
<td>54</td>
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<td>Sketoe, J.G.</td>
<td>46</td>
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<tr>
<td>Skofronick-Jackson, G.M.</td>
<td>46, 52</td>
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<tr>
<td>Slade, K.N.</td>
<td>47</td>
</tr>
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<td>Smith, A.W.</td>
<td>41, 55</td>
</tr>
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<td>Smith, C.A.</td>
<td>49</td>
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<td>Smith, E.A.</td>
<td>47</td>
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<td>Smith, G.A.</td>
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<td>Smith, S.</td>
<td>42</td>
</tr>
<tr>
<td>Smith, W.S.</td>
<td>38, 41, 55</td>
</tr>
<tr>
<td>Smitherman, D.V., Jr.</td>
<td>47</td>
</tr>
<tr>
<td>Smithers, G.A.</td>
<td>15, 46</td>
</tr>
<tr>
<td>Snell, E.H.</td>
<td>28, 32, 40</td>
</tr>
<tr>
<td>Sohn, B.-J.</td>
<td>47</td>
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<tr>
<td>Solakiewicz, R.J.</td>
<td>33</td>
</tr>
<tr>
<td>Soundararajaperumal, S</td>
<td>24</td>
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<tr>
<td>Spann, J.F.</td>
<td>19, 23, 36, 37, 39, 47, 51, 53</td>
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<td>Sparks, D.</td>
<td>17</td>
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<td>Sparks, D.L.</td>
<td>45</td>
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<td>Speegle, C.O.</td>
<td>41, 47</td>
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<tr>
<td>Spencer, R.W.</td>
<td>47</td>
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<tr>
<td>Speybroeck, L.P.</td>
<td>53</td>
</tr>
<tr>
<td>Spohnholtz, T.</td>
<td>21</td>
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<tr>
<td>Sportiello, M.G.</td>
<td>32</td>
</tr>
<tr>
<td>Springer, A.M.</td>
<td>47</td>
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<tr>
<td>Srivastava, V.</td>
<td>31</td>
</tr>
<tr>
<td>Stahl, P.</td>
<td>22, 42</td>
</tr>
<tr>
<td>Stanley, T.T.</td>
<td>47</td>
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<td>Starr, D.O.</td>
<td>53</td>
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<td>Steadman, T.</td>
<td>29</td>
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<tr>
<td>Stefanescu, D.M.</td>
<td>47, 48</td>
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<tr>
<td>Stephen, J.B.</td>
<td>35</td>
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<tr>
<td>Stephenson, A.</td>
<td>24</td>
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<tr>
<td>Sterling, A.C.</td>
<td>37, 48</td>
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<td>Stevenson, B.A.</td>
<td>29, 48, 50, 55</td>
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<td>Stevenson, D.</td>
<td>54</td>
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<td>Stewart, E.T.</td>
<td>54</td>
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<tr>
<td>Stock, J.M.</td>
<td>37</td>
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<tr>
<td>Stone, N.H.</td>
<td>33, 44, 55</td>
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<tr>
<td>Su, C.-H.</td>
<td>17, 48, 55, 56</td>
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<td>Su, Y.-J.</td>
<td>29, 55</td>
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<td>Su, Y.U.</td>
<td>48</td>
</tr>
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<td>Suess, S.T.</td>
<td>39, 47, 48, 49</td>
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<tr>
<td>Suggs, R.M.</td>
<td>16, 18, 34</td>
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<td>Sumida, J.</td>
<td>35, 40, 49</td>
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<td>Sumrall, J.</td>
<td>49</td>
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<td>Sun, X.</td>
<td>36</td>
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<td>Sutherland, S.</td>
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<td>Swanson, G.R.</td>
<td>14, 49</td>
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<td>Swartz, D.A.</td>
<td>16, 21, 33, 49</td>
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<td>Szofran, F.R.</td>
<td>33, 34, 45, 49</td>
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<td>Tananbaum, H.</td>
<td>53</td>
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<td>Tang, W.</td>
<td>36</td>
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<td>Tennant, A.F.</td>
<td>16, 21, 45, 53</td>
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<td>Thomas, L.D.</td>
<td>49</td>
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<td>Thomas, R.J.</td>
<td>40, 49</td>
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<td>Tidwell, P.</td>
<td>19</td>
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<td>Tiller, B.</td>
<td>35, 44</td>
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<tr>
<td>Timofeeva, T.V.</td>
<td>49</td>
</tr>
<tr>
<td>Tinker, M.L.</td>
<td>15, 47</td>
</tr>
<tr>
<td>Tobin, D.</td>
<td>53</td>
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<td>Todd, P.</td>
<td>32</td>
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<td>Toutanji, H.A.</td>
<td>49</td>
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<td>Townsend, J.S.</td>
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<td>44</td>
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<td>31</td>
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<td>Tratt, D.M.</td>
<td>43</td>
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<td>Trinh, H.P.</td>
<td>22, 50, 52</td>
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<td>22, 50</td>
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<td>46, 50</td>
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<td>Van Dyke, M.</td>
<td>25, 29, 30, 51</td>
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<tr>
<td>Van Speybroeck, L.</td>
<td>53</td>
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<tr>
<td>Vaughan, W.W.</td>
<td>32</td>
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<tr>
<td>Vaughn, J.A.</td>
<td>20, 23, 44, 51</td>
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<td>Name</td>
<td>Page Numbers</td>
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<tr>
<td>Vaughn, J.R.</td>
<td>55</td>
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<td>Venturini, C.C.</td>
<td>47, 51</td>
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<tr>
<td>Vikram, C.S.</td>
<td>51</td>
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<tr>
<td>Virani, S.N.</td>
<td>16</td>
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<td>Volz, M.P.</td>
<td>41, 48, 49, 51, 52</td>
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<td>52</td>
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<td>33, 45, 49</td>
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<td>36</td>
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<td>Wang, F.C.</td>
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<td>24, 46, 52</td>
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<td>52</td>
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<td>Wang, L.J.</td>
<td>48</td>
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<td>26, 30, 34, 52</td>
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<td>52</td>
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<td>Weisskopf, M.C.</td>
<td>21, 41, 52, 53</td>
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<td>West, E.A.</td>
<td>40, 53</td>
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<td>West, M.</td>
<td>40</td>
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<td>Whitaker, A.F.</td>
<td>53</td>
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<td>White, N.</td>
<td>18</td>
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<tr>
<td>Whiteman, D.N.</td>
<td>53</td>
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<tr>
<td>Whorton, M.S.</td>
<td>25, 27, 46, 53</td>
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<td>54</td>
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<td>Wilson, C.A.</td>
<td>27, 36, 54</td>
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<td>Wilson-Hodge, C.A.</td>
<td>23, 54</td>
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<td>Wingard, C.D.</td>
<td>54</td>
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<td>Witherow, W.K.</td>
<td>14, 50, 51</td>
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<td>54</td>
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<td>Wright, E.</td>
<td>41</td>
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<td>Wright, K.H., Jr.</td>
<td>44, 55</td>
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<td>55</td>
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<td>55</td>
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<td>29, 50</td>
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<td>Wu, X.O.</td>
<td>55</td>
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<td>Yeh, Y.P.</td>
<td>41, 54</td>
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<td>15</td>
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<td>Young, R.B.</td>
<td>55</td>
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<td>Young, R.M.</td>
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<td>Zeng, W.</td>
<td>29, 55</td>
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<td>Zhang, S.N.</td>
<td>27, 35</td>
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<td>55</td>
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<td>Zhao, J.</td>
<td>55</td>
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<td>Zhu, J.J.</td>
<td>55</td>
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<tr>
<td>Zhu, S.</td>
<td>48, 55, 56</td>
</tr>
<tr>
<td>Zimmerman, F.R.</td>
<td>57</td>
</tr>
<tr>
<td>Zissa, D.</td>
<td>46</td>
</tr>
<tr>
<td>Zoladz, T.F.</td>
<td>30, 57</td>
</tr>
</tbody>
</table>
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