NASA Technical Memorandum

NASA TM-100346

FY 1988 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by Joyce E. Turner
Management Operations Office

October 1988


N89-18253

CSCL 05B

Unclas

G3/82 0191268

NASA
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
<table>
<thead>
<tr>
<th>1. REPORT NO.</th>
<th>NASA TM-100346</th>
<th>2. GOVERNMENT ACCESSION NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. AUTHOR(S)</td>
<td>Compiled by Joyce E. Turner</td>
<td>8. PERFORMING ORGANIZATION REPORT #</td>
</tr>
<tr>
<td>12. SPONSORING AGENCY NAME AND ADDRESS</td>
<td>National Aeronautics and Space Administration Washington, D.C. 20546</td>
<td>11. CONTRACT OR GRANT NO.</td>
</tr>
<tr>
<td>16. ABSTRACT</td>
<td>This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY 88. It also includes papers of MSFC contractors. After being announced in STAR, all of the NASA series reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The information in this report may be of value to the scientific and engineering community in determining what information has been published and what is available.</td>
<td>18. DISTRIBUTION STATEMENT</td>
</tr>
<tr>
<td>19. SECURITY CLASSIF. (of this report)</td>
<td>Unclassified</td>
<td>20. SECURITY CLASSIF. (of this page)</td>
</tr>
<tr>
<td>21. NO. OF PAGES</td>
<td>66</td>
<td>22. PRICE</td>
</tr>
</tbody>
</table>
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 NASA Scientific and Technical Information Facility, Baltimore, Maryland, 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, Virginia 22161. The N number should be cited when ordering.
**TABLE OF CONTENTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA TECHNICAL MEMORANDA</td>
<td>1</td>
</tr>
<tr>
<td>NASA TECHNICAL PAPERS</td>
<td>10</td>
</tr>
<tr>
<td>MSFC CONFERENCE PUBLICATIONS</td>
<td>14</td>
</tr>
<tr>
<td>NASA CONTRACTOR REPORTS</td>
<td>15</td>
</tr>
<tr>
<td>MSFC PAPERS CLEARED FOR PRESENTATION</td>
<td>30</td>
</tr>
</tbody>
</table>
Detonations were experienced in the Space Shuttle Main Engine fuel preburner (FPB) augmented spark igniter (ASI) during engine cutoff. Several of these resulted in overpressures sufficient to damage the FPB AS1 oxidizer system. The detonations initiate in the FPB AS1 oxidizer line when residual oxidizer (oxygen) in the line mixes with backflowing fuel (hydrogen) and detonates. This report reviews the damage history to the FPB AS1 oxidizer system, an engineering assessment of the problem cause, a verification of the mechanisms, the hazards associated with the detonations, and the solution implemented.
This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY 87. It also includes papers of MSFC contractors.

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

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

TM-100319 February 1988

This report describes the results of an experimental investigation of phenomena associated with the oblique hypervelocity impact of spherical projectiles on multi-sheet aluminum structures. A model that can be employed in the design of meteoroid and space debris protection systems for space structures is developed. The model consists of equations that relate crater and perforation damage of a multi-sheet structure to parameters such as projectile size, impact velocity, and trajectory obliquity. The equations are obtained through a regression analysis of oblique hypervelocity impact test data. This data shows that the response of a multi-sheet structure to oblique impact is significantly different from its response to normal hypervelocity impact. It was found that obliquely incident projectiles produce ricochet debris that can severely damage panels or instrumentation located on the exterior of a space structure. Obliquity effects of high-speed impact must, therefore, be considered in the design of any structure exposed to the meteoroid and space debris environment.

TM-100321 February 1988

For several years, the Marshall Space Flight Center has pursued the coordinated development of a Large Space Structures (LSS) National Test Bed for the investigation of numerous technical issues involved in the use of LSS in space. This paper describes the origins of this development, the current status of the various test facilities and the plans laid down for the next five years’ activities. Particular emphasis on the control and structural interaction issues has been paid so far; however, immediately emerging are user applications (such as the proposed pinhole occultor facility). In the immediate future, such emerging technologies as smart robots and multibody interactions will be studied. These areas are covered in this report.

TM-100322 March 1988
Test Results of High-Voltage, High-Power, Solid-State Remote Power Controllers. Yvette Binford Johnson and Robert E.
This report discusses the results of testing high-voltage, high-power, solid-state remote power controllers (RPC) using RPC's designed and built by John C. Sturman at the Lewis Research Center, Cleveland, Ohio, and utilizing the Autonomously Managed Power Systems (AMPS) breadboard/test facility. These test results are used to determine usefulness of the RPC's for future applications in high voltage Direct-Current space power.

Analysis of Contamination Data Recorded by the IECM Camera/Photometer. K. Stuart Clifton and Carl M. Benson. Space Science Laboratory. N88-21246

The Camera/Photometer was one of ten instruments comprising the Induced Environment Contamination Monitor (IECM) developed to monitor the contamination about the space shuttle Orbiter during early shuttle missions. This experiment consisted of two motion picture cameras, integrating photometers, and associated electronics enclosed in pressurized canisters and separated by 40 cm in order to make stereoscopic observation of particulates. The objectives of the experiment were to record the occurrence of particulates and to determine their velocities, sizes, and origins, as well as to measure the background brightness due to unresolved particles. Particle tracks were detected on over 1,800 data frames recorded during continuous operations throughout STS-2, -3, -4, and -9. This report discusses the analysis techniques employed in reducing the subsequent results, with an emphasis placed on particle size and velocity data. It also describes the operation of the overall experiment and some of the results obtained.


The old concept of using the wake of a spacecraft to obtain an ultrahigh vacuum is revisited with a somewhat different emphasis. Since it is possible to configure a wake shield so that a surface of interest does not subtend any walls that could become contaminated, it appears that it should be possible to achieve a contamination-free, ultrahigh vacuum capability with infinite pumping speed even in the presence of high heat loads and moderate gas loads. With the new interest in developing thin films with precision controlled synthetic microstructures such as superlattices, mixed metal oxide high temperature superconductors, rare-Earth magnetooptical devices, and nano-crystalline alloys, the ability to work with a variety of different materials without cross contamination should be of significant importance. This paper analyzes the performance of the conceptual design for a Space Ultravacuum Research Facility (SURF), both in a Shuttle-attached mode and as a free-flyer. It is shown that even in the Shuttle-attached mode, it should be possible to obtain vacuum levels equivalent to 10^{-10} Torr with O and N_2 as the primary constituents. This should be sufficient to demonstrate the feasibility of the concept, particularly the infinite pumping speed and virtual elimination of contamination aspects. As a free-flyer the SURF will be limited primarily by the gas load associated with the process being performed. For chemical beam epitaxy (CBE) it is shown that equivalent vacuum levels of 10^{-14} Torr should be possible at 300 km.


This report describes the use of the NASA-LEWIS Chemical Equilibrium Program to design
rocket nozzles for the minimum pressure consistent with specified values of nozzle exit diameter, combustion-gas flow rate, and vacuum specific impulse. Since the latter two quantities are the components of vacuum thrust, parametric studies of constant-thrust conditions may also be made. Although the computer implementation employed is described in an appendix, necessary calculations can also be made with an iterative method requiring no computer capability beyond that of running the NASA-LEWIS program itself. This iteration is also described in an appendix.

The procedure developed was originally programmed on a CDC 760 computer under the designation MINPRESS. The procedure has now been programmed on the VAX computer at Marshall Space Flight Center as LEWIS 2. Both versions generate tables of nozzle expansion and pressure ratios so that the tabular inputs described in this documentation are not required.

Application of the LEWIS 2 program to the parametric design of possible liquid booster alternatives to the solid boosters of the Space Shuttle is illustrated in Appendix V.

Based upon the evaluation of the changes in these properties, it is concluded that properly applied and topcoat-protected TPS can satisfactorily withstand the conditions of the natural environment at KSC for exposures up to six months.

This report relates the analytical sensitivity studies accomplished on a carbon-carbon nozzle exit cone especially built and hot fired for NASA-MSFC under an engineering verification and technology program. The analysis was performed using an incremental nonlinear axisymmetric continuum element code developed explicitly to handle composite involute construction designs. Material and geometric parameters are varied, with the effect of these changes noted at several key structural locations along the carbon-carbon exit cone.

This report summarizes the effort to demonstrate, by real-time exposure, the effects of the natural environment at Kennedy Space Center, Florida, upon the Thermal Protection System (TPS) of the Solid Rocket Booster (SRB), and to verify that the overall SRB TPS configuration meets all requirements for resistance to the conditions associated with outdoor weathering, including: (1) solar radiation, (2) temperature, (3) humidity, (4) precipitation, (5) wind, (6) sand/dust abrasion, (7) static electricity, (8) salt spray, (9) fungus, and (10) atmospheric oxidants.

The evaluation criterion for this project was based upon flatwise tensile properties, visual inspection, color change, and thermal performance.
This document contains a general approach for structural design and verification used for determining the structural margins of the space vehicle elements under Marshall Space Flight Center (MSFC) management. The Space Shuttle results and organization will be used as illustrations for techniques discussed. Discussed are (1) the system analyses performed or to be performed by and (2) element analyses performed by MSFC and their contractors. Analysis approaches and their verification will be addressed. The Shuttle procedures are general in nature and apply to other than Shuttle space vehicles.

TM-100333 May 1988
X88-10357

The nickel-based superalloy MAR-M246(Hf) was studied to determine an alternate heat treatment that could enhance the alloy's morphology and fatigue properties by optimizing the solution and aging treatment variables. Several solution treatments and combinations of solution and aging treatments were studied and compared to the standard heat treatment for beneficial changes in the γ' and γ-γ' eutectic morphology. The microstructure was found to be more uniform when the solution treatment time was reduced to 1 hour at 1221°C. The Weibull analysis performed on fatigue data results shows slightly improved fatigue properties for this reduced solution treatment of 1 hour at 1221°C with standard aging.

TM-100335 May 1988
Description of Graphics Translation Software Between Integraph and Tektronix Systems. Tom Rieckhoff, Jeff Hixson, and Mark Covam. Propulsion Laboratory.
N88-24202

The requirement for Marshall Space Flight Center's Photo Analysis to use existing three-dimensional Integraph graphic files on an existing 'Tektronix 4129 three-dimensional graphics workstation and the unavailability of an off-the-shelf Integraph to Tektronix translator required the development of such a translator. Using the output of Integraph's standard interchange format converter, the three-dimensional graphic information of Integraph's files are reformatted and compressed. The three-dimensional image is reconstructed using Tektronix's software terminal interface graphic library (STI).

TM-100336 June 1988
N88-27181

This report describes how guide stars are selected for the Optical Sensor Package (OSP) for
the Instrument Pointing System (IPS) when it is operating in the stellar mode on the ASTRO missions. It also describes how the objective loads are written and how the various roll angles are related; i.e., the celestial roll or position angle, the objective load roll angles, and the IPS gimbal angles. There is a brief description of how the IPS operates and its various modes of operation; i.e., IDOP, IDIN, and OSPCAL.

TM-100337 July 1988

N88-28300

A simplified model of a pointing control system for balloon-borne solar experiments is chosen. Equations of motion for this model are derived and a feedback control law is defined. A digital computer simulation of the system is developed. Simulation results show favorable system response characteristics.

TM-100338 August 1988
An Application of “High Authority/Low Authority Control” and “Positivity.” S. M. Seltzer, D. Irwin, D. Tollison, and H. B. Waites. Structures and Dynamics Laboratory.

Control Dynamics Company (CDy), in conjunction with NASA Marshall Space Flight Center (MSFC), has supported the U.S. Air Force Wright Aeronautical Laboratory (AFWAL) in conducting an investigation of the implementation of several Department of Defense controls techniques. These techniques are to provide vibration suppression and precise attitude control for flexible space structures. AFWAL issued a contract to Control Dynamics to perform this effort under the Active Control Technique Evaluation for Spacecraft (ACES) Program. Dr. Henry B. Waites (MSFC) was the Principal Investigator, Dr. George B. Doane III (CDy) was the Program Manager, and Dr. R. Dennis Irwin (formerly CDy, presently Ohio University) was the Project Leader. The “High Authority Control/Low Authority Control” (HAC/LAC) and “Positivity” controls techniques, which were cultivated under the DARPA Active Control of Space Structures (ACOSS) Program, were applied to a structural model of the NASA/MSFC Ground Test Facility ACES configuration. Mr. Danny K. Tollison performed the HAC/LAC evaluation, and Mr. Jeffrey Lucas performed the Positivity evaluation. The control system designs were accomplished, and linear post-analyses of the closed-loop systems are provided. The control system designs take into account effects of sampling and delay in the control computer. Nonlinear simulation runs were used to verify the control system designs and implementations in the facility control computers. Finally, test results are given to verify operations of the control systems in the test facility.

TM-100339 August 1988

This report provides a description of the NASA Marshall Space Flight Center’s Solar Vector Magnetograph Facility and gives a summary of its observations and data reduction during January-March 1988. The systems that make up the facility are a magnetograph telescope, an H-alpha telescope, a Questar telescope, and a computer center. The data are represented by longitudinal contours with azimuth plots.

TM-100340 September 1988

Methods for the growth of polydiacetylene thin films by melt and vapor growth and their
subsequent polymerization are summarized. Films with random orientations were obtained when glass or quartz were used as substrates in the vapor growth process. Oriented polydiacetylene films were fabricated by the vapor deposition of diacetylene monomer onto oriented polydiacetylene on a glass substrate and its subsequent polymerization by UV light. A method for the growth of oriented thin films by a melt-shear growth process as well as a method of film growth by seeded recrystallization from the melt between glass plates, that may be applied to the growth of polydiacetylene films, are described. Moreover, a method is presented for the fabrication of single crystal thin films of polydiacetylenes by irradiation of the surface of diacetylene single crystals to a depth between 100 and 2000 Å.

TM-100341 September 1988

The growth of single crystals of organic compounds by the Czochralski method has been reviewed. From the literature, single crystals of benzil, a nonlinear optical material with a $d_{11}$ value of $11.2 \pm 1.5 \times d_{11}$ value of α quartz, has fewer dislocations than generally contained in Bridgman crystals. More perfect crystals were grown by repeated Czochralski growth. This consists of etching away the defect-containing portion of a Czochralski grown crystal and using it as a seed for further growth. Other compounds used to grow single crystals are benzophenone, 12-tricosanone (laurone), and salol. The physical properties, growth apparatus, and processing conditions presented in the literature are discussed. Moreover, some of the possible advantages of growing single crystals of organic compounds in microgravity to obtain more perfect crystals than on Earth are reviewed.

TM-100342 September 1988

In December 1986, a Center Director's Discretionary Fund (CDDF) proposal was granted to study power system control techniques in large space electrical power systems. This paper presents the accomplishments in the area of power system control by power quality load management. In addition, information concerning the distortion problems in a 20 kHz ac power system is presented.

TM-4014 September 1987

The purpose of this report is to present an analysis of the bivariate parameter differences between the FPS-16 Radar/Jimsphere and the Meteorological Sounding System (MSS) Windsonde. The Jimsphere is used as the standard to measure the ascent wind loads during the Space Shuttle launches at Kennedy Space Center, Florida, and the Windsonde is the backup system. In addition, in the report a discussion of the terrestrial environment (below 20 km) and a description of the Jimsphere and Windsonde wind sensors are given. Computation of the wind statistics from 64 paired Jimsphere and Windsonde balloon releases in support of 14 Space Shuttle launches shows good agreement between the two wind sensors.

The computed difference values in m/s of the mean zonal wind ($\bar{u}$) and mean meridional wind ($\bar{v}$) of the Jimsphere and Windsonde at 500 m intervals from the surface to 16 km shows good agreement between the wind components. The $\bar{u}$ and $\bar{v}$ mean differences for the 64 paired observations were 0.16 and 0.22 m/s, respectively, while the standard deviations of the mean differences of $\bar{u}$ and $\bar{v}$ were 1.38 and 1.73 m/s, respectively.
From the analysis of the buildup and back-off data for various scales of distance and the comparison of the cumulative percent frequency (CPF) versus wind speed change, it is shown that the wind speed change for various scales of distances (m) 100, 200, 400, 600, 800, 1000, 2000, 3000, and 5000 for the Jimsphere and Windsonde compare favorably. For example, the average altitude, where the greatest buildup occurred for all the scales of distances was at 10,427 m for the Jimsphere, 10,529 m for the Windsonde, and 10,474 m for the Jimsphere/Windsonde pairs, a range of only 102 m. The S.D. of these parameters were 2999, 3029, and 3007 m, less than a 50 m difference.

The variance difference of energy for the Power Spectral Density parameters for the u and v components of the Jimsphere and Windsonde was less than ±0.02 m²/sec². This showed very good agreement between the Jimsphere Wind sensor and its backup, the Windsonde in the all-important variance parameter, the energy difference between the Jimsphere and Windsonde at various wavenumbers or wavelengths.

TM-4035 March 1988
Description of MSFC Engineering Photographic Analysis. Jim Earle and Frank Williams. Propulsion Laboratory. N88-18900

Utilizing a background that includes development of basic launch and test photographic coverage and analysis procedures, the MSFC Photographic Evaluation Group has built a field of experience that enables it to effectively satisfy MSFC's engineering photographic analysis needs. Combining the basic soundness of reliable, proven techniques of the past with the newer technical advances of computers and computer-related devices, the MSFC Photo Evaluation Group is in a position to continue to provide photo and video analysis service center-wide and NASA-wide to provide an improving photo analysis product to meet the photo evaluation needs of the future; and to provide new standards in the state-of-the-art of photo analysis of dynamic events.

TM-4048 June 1988

This report presents the results of a pre-phase A study performed by the Marshall Space Flight Center's (MSFC) Solar Science Branch for the Air Force Geophysics Laboratory (AFGL) to develop a design concept for a space-based solar vector magnetograph and hydrogen-alpha telescope. As two of the three core instruments for the proposed AFGL Solar Activity Measurements Experiments (SAMEX) satellite, these instruments were designed to provide high-resolution observations of the solar magnetic field in the photosphere and chromosphere. The MSFC ground-based vector magnetograph served as the prototype for the space-based instrument. The primary scientific objective of the SAMEX mission is to understand the role of the Sun's magnetic field in the physics of solar flares. This and other related objectives developed for the SAMEX mission imposed the following instrumental requirements on the vector magnetograph: (1) a temporal resolution of <5 min, (2) a field of view of 4.3 x 8.5 arc min to cover most active regions, (3) a spatial resolution of 0.5 arc sec, (4) a spectral range covering the wavelengths from 524.3 to 525.4 nm, and (5) a polarimetric sensitivity of 10⁻⁴ to measure the solar magnetic field with greater accuracy than has been done with any other system. The polarimetric accuracy of 10⁻⁴ was obtained through the use of specially designed optical coatings on the fore-optics and the design of a unique polarimeter. To obtain observations of entire active regions with 0.5 arc sec spatial resolution in less than 5 min required the design of a large-array, charge coupled device
(CCD) detector with parallel processing electronics. This report discusses the SAMEX scientific objectives and presents the designs of the optics, polarimeter, spectral filters, and detector that are required to meet these objectives. The report also discusses the numerous trade-offs among spatial resolution, areal coverage, temporal resolution, spectral response, and telemetry that must be considered in achieving the design goals. Spacecraft and mission requirements and requirements for data reduction and analysis are also covered in the report.

TM-4059 August 1988

Marshall Space Flight Center supported 122.6 hours of flight time in the KC-135 aircraft based at Ellington Field, in Houston, Texas, from FY84 through FY86. During this period, 17 different experiments were flown with several repeating or continuous research, having accumulated over 1554 parabolas. During these parabolas, there were various gravity levels from near zero to 2.2. The number of hours and parabolas increased significantly over past years and testifies to the increasing interest in the KC-135 aircraft usage.

This report compiles the results of tests by various experimenters in the microgravity aircraft program at Marshall Space Flight Center for this period.

TM-4066 September 1988

The purpose of this report is to present the emerging technology of electromagnetic probing of the atmosphere to measure winds used in space vehicle's ascent winds load calculations. The frequency range, altitude, and resolution for the following probes are presented: lidars, microwave radars, and clear-air Doppler radars (popularly known as wind profilers).

The electromagnetic probing of the atmosphere by clear-air radars and lasers is the new technology to supplement balloon-borne wind sensors which are used to determine ascent wind loads of space vehicles. The electromagnetic probes measure the wind velocity using the Doppler effect. This is the radar technology used in MSFC's Radar Wind Profiler, and is similar to the technology used in conventional Doppler systems except the frequency is generally lower, antenna is bigger, and dwell time is much longer. Designed for unattended and automated instrumentation in providing measurements of the wind in the troposphere, the profiler employs Doppler radar technology and is currently being put in operation at NASA's Kennedy Space Center, Florida.

TM-4076 September 1988
Rechargeable Metal Hydrides for Spacecraft Application. J. L. Perry. Structures and Dynamics Laboratory.

Storing hydrogen on board the Space Station presents both safety and logistics problems. Conventional storage using pressurized bottles requires large masses, pressures, and volumes to handle the hydrogen which will be used by experiments in the U.S. Laboratory Module and residual hydrogen generated by the ECLSS. Rechargeable metal hydrides may be competitive with conventional storage techniques. The basic theory of hydride behavior is presented and the engineering properties of LaNi₅ are discussed to gain a clear understanding of the potential of metal hydrides for handling spacecraft hydrogen resources. Applications to the Space Station and the safety of metal hydrides are presented and compared to conventional pressurized storage. This comparison indicates metal hydrides may be safer and require a lower pressure, less volume, and less mass to store an equivalent mass of hydrogen.

A basic premise of continuous flow electrophoresis is that removal of buoyancy-induced thermal convection caused by axial and lateral temperature gradients will result in ideal performance of these instruments in space. Although these gravity dependent phenomena disturb the rectilinear flow in the separation chamber when high voltage gradients and/or thick chambers are used, distortion of the injected sample stream due to electrohydrodynamic effects causes major broadening of the separated bands.

Although the electrophoresis separation process is simple in concept, flows local to the sample filament produced by the applied electric field have not been considered. These electrohydrodynamic flows, formulated by G. I. Taylor in 1965 for drops suspended in various liquids, distort the sample stream and limit the separation. In addition, electroosmosis and viscous flow, which are inherent in the continuous flow electrophoresis device, combine to further disturb the process. Electroosmosis causes a flow in the chamber cross section which directly distorts the sample stream, while viscous flow causes a parabolic profile to develop in the flow plane. This flow profile in turn distorts migration by causing a varying residence time across the thickness of the chamber. Thus, sample constituents at the center plane will be in the electric field a shorter time and hence move less than comparable constituents closer to the chamber wall.

A moving wall concept is being proposed for space which will eliminate and/or control all of the above-mentioned disturbances. The moving wall will entrain the fluid to move as a rigid body and hence produce a constant residence time for all samples distributed across the chamber thickness. By aligning the moving wall at an angle to the chamber axis, a component of the moving wall motion can be made to oppose and hence cancel the electroosmotic flow. In the absence of electrokinetic effects, i.e., electroosmosis, the electro-hydrodynamical effect manifests itself as a ribbon, being either vertical (perpendicular to the electric field) or horizontal (aligned with the electric field) depending on the ratio of conductivity of the sample to that of the buffer. Therefore, by using low conductivity sample solutions to provide a vertical ribbon, the moving wall concept should produce distortion-free separations.

The moving wall electrophoresis chamber can only be operated in space because there is no viscous flow in the chamber to stabilize against thermal convection. Laboratory prototype instruments have been built which confirm the sensitivity of their operation. These prototypes have also identified engineering problems such as liquid seals. However, the moving wall electrophoresis system is a concept designed for space which should permit preparative electrophoresis to attain its potential.


In 1978, McDonnell Douglas Astronautics Company (MDAC) began discussions with NASA on the opportunities to develop a space continuous flow electrophoresis system (CFES) that would incorporate specific modifications to their laboratory instruments to take advantage of weightlessness. A Joint Endeavor Agreement (JEA) that allocated certain flights on the Space Shuttle to MDAC in return for opportunities for NASA and interested scientists to do research in the MDAC laboratory and on their space instruments was made.

Under terms of the JEA, NASA was provided an opportunity to process two samples on STS-6. All experiment objectives and operational parameters, such as applied field, sample residence time in the field, and buffer composition

TP-2777
October 1987

N88-10977
had to accommodate the MDAC capabilities and NASA flight constraints. The NASA objectives were formulated so as to include investigation of the sample concentration effects reported by MDAC on STS-4. The specific objectives were (1) to use a model sample material at a high concentration to evaluate the continuous flow electrophoresis process in the MDAC CFES instrument and compare its separation resolution and sample throughput with related devices on Earth and (2) to expand our basic knowledge of the limitations imposed by fluid flows and particle concentration effects on the electrophoresis process by careful design and evaluation of the space experiment.

Because the MDAC instrumentation did not include sample mixing facilities, cell separation procedures were precluded and after a variety of soluble materials were considered, hemoglobin and polysaccharide were selected as primary samples. The results from space show a large band spread of the high concentration of the single species of hemoglobin that was principally due to the mismatch of electrical conductivity between the sample and buffer.

The seventh mission of the Space Shuttle carried two additional NASA experiments in the CFES instrument. The major objective was to evaluate the influence of the electrical properties of the sample constituents on the resolution of the continuous flow electrophoresis device. As expected, the polystyrene latex microspheres dispersed in a solution with three times the electrical conductivity of the curtain buffer separated with a significantly larger band spread than in to the second experiment under matched conductivity conditions. The structure of the bands is also different between the samples, and laboratory experiments have been conducted to further evaluate the phenomena affecting the electrophoresis. The analysis of both flight results is nearing completion and a qualitative explanation based upon the non-gravity dependent electrical conductivity mismatch is being developed.

TP-2787 December 1987

Based on the thermophysical properties of Hg_{1-x}Cd_{x}Te alloys, the reasons are discussed for the failure of conventional Bridgman-Stockbarger growth methods to produce high quality homogeneous crystals in the presence of Earth's gravity. The deleterious effects are considered which arise from the dependence of the thermophysical properties on temperature and composition and from the large amount of heat carried by the fused silica ampules. An improved growth method, developed to optimize heat flow conditions, is described and experimental results are presented. The problems associated with growth in a gravitational environment are discussed. The anticipated advantages of growth in microgravity are given and the implications of the requirements for spaceflight experiments are summarized.

TP-2793 February 1988

A study was conducted to evaluate the performance implications of heads-up ascent flight design for the Space Transportation System, as compared to the current heads-down flight mode. The procedure involved the use of the Minimum Hamiltonian Ascent Shuttle Trajectory Evaluation program, which is a three-degree-of-freedom moment balance simulation of shuttle ascent. A minimum-Hamiltonian optimization strategy was employed to maximize injection weight as a function of maximum dynamic pressure constraint and Solid Rocket Motor burnrate. Performance Reference Mission Four trajectory groundrules were used in all cases for consistency. The major conclusions are that for heads-up ascent and a mission nominal design maximum dynamic pressure value of 680 psf, the optimum solid motor burnrate is 0.394 ips. This
optimum burnrate produces a performance enhancement of 4293 lbm relative to the baseline heads-down ascent, with 0.368 ips burnrate solid motors and a 680 psf dynamic pressure constraint. However, no performance advantage exists for heads-up flight if the current Solid Rocket Motor target burnrate of 0.368 ips is used. The advantage of heads-up ascent flight employing the current burnrate is that Space Shuttle Main Engine throttling for dynamic pressure control is not necessary.

TP-2807 February 1988

This paper describes a generalized method for controlling a six degree-of-freedom (DOF) robot and a two DOF positioner used for arc welding operations. The welding path is defined in the part reference frame, and robot/positioner joint angles of the equivalent eight DOF serial linkage are determined via an iterative solution. Three algorithms are presented: the first solution controls motion of the eight DOF mechanism such that proper torch motion is achieved while minimizing the sum-of-squares of joint displacements; the second algorithm adds two constraint equations to achieve torch control while maintaining part orientation so that welding occurs in the downhand position; and the third algorithm adds the ability to control the proper orientation of a wire feed mechanism used in gas tungsten arc (GTA) welding operations. A verification of these algorithms is given using ROBOSIM, a NASA developed computer graphic simulation software package designed for robot systems development.

TP-2820 May 1988
An Electrochemical Study of Corrosion Protection by Primer-Topcoat Systems on 4130 Steel with AC Impedance and DC Methods. M. J. Mendrek, R. H. Higgins, and M. D. Danford. Materials and Processes Laboratory. X88-10270

In an effort to investigate metal surface corrosion and the breakdown of metal protective coatings, the AC impedance method was applied to six systems of primer coated and primer topcoated 4130 steel. Two primers were used: a zinc-rich epoxy primer and a red lead oxide epoxy primer. The epoxy-polyamine topcoat was used in four of the systems. The EG&G-PARC Model 368 AC impedance measurement system, along with DC measurements with the same system using the polarization resistance method, was used to monitor changing properties of coated 4130 steel disks immersed in 3.5 percent NaCl solutions buffered at pH 5.4 over periods of 40 to 60 days. The corrosion system can be represented...
by an electronic analog called an equivalent circuit that consists of resistors and capacitors in specific arrangements. This equivalent circuit parallels the impedance behavior of the corrosion system during a frequency scan. Values for the resistors and capacitors, that can be assigned in the equivalent circuit following a least squares analysis of the data, describe changes that occur on the corroding metal surface and in the protective coatings. Two equivalent circuits have been determined that predict the correct Bode phase and magnitude of the experimental sample at different immersion times. DC corrosion current density data are related to equivalent circuit element parameters. Methods for determining corrosion rate with AC impedance parameters are verified by the DC method.

TP-2821 May 1988
SRM Propellant and Polymer Materials Structural Test Program. Dr. Carleton J. Moore. Structures and Dynamics Laboratory. N88-25013

The SRM propellant and polymer materials structural test program has potentially wide application to the testing and structural analysis of polymer materials and other materials generally characterized as being made of viscoelastic materials. The test program will provide a basis for characterization of the dynamic failure criteria for Solid Rocket Motor (SRM) propellant, insulation, inhibitor, and liners. This experimental investigation will also endeavor to obtain a consistent complete set of materials test data. This test data will be used to improve and revise the presently used theoretical math models for SRM propellant, insulation, inhibitor, liners, and seal O-rings.

TP-2842 September 1988
The Hydrides of Titanium and Ti-5Al-2.5Sn. Merlin D. Danford. Materials and Processes Laboratory.

Hydrogen diffusion coefficients in titanium and Ti-5Al-2.5Sn alloys, as obtained by electrochemical measurements, have been determined at 25°C. Also, electrochemical measurements using cylindrical samples have indicated that the initial hydrogen distributions are essentially uniform in nature on charging at 25°C, attributed to the fact that there is a larger number of interstitial positions available in the hexagonal close-packed titanium structure. Both electrochemical and fusion measurements show that about all hydrogen is of the trapped variety in these materials on electrolytic charging and the stability of the metal hydrides is quite high. Stress has the effect of releasing trapped hydrogen to form the mobile variety, a result which may require a re-evaluation of the effect of stress on hydrogen movement. The structures of pure titanium and the titanium alloys are also discussed as well as the nature of bonding in these alloys.

TP-2847 September 1988

This paper presents a special form of the Ideal State Reconstructor for deterministic digital control systems which is simpler to implement than the most general form. The Ideal State Reconstructor is so named because: if the plant parameters are known exactly, its output will exactly equal, not just approximate, the true state of the plant and accomplish this without any knowledge of the plant's initial state. Besides this, it adds no new states or eigenvalues to the system. Nor does it affect the plant equation for the system in any way; it affects the measurement equation only. It is characterized by the fact that discrete measurements are generated every T/N seconds and input into a multi-input/multi-output moving-average (MA) process. The output of this process is sampled every T seconds and utilized in reconstructing the state of the system.
NASA CONFERENCE PUBLICATIONS

CP-2488 October 1987
58th Shock and Vibration Symposium.
Compiled by Walter and Barbara Pilkey.
N88-13609

CP-2488 October 1987
58th Shock and Vibration Symposium. Volume II.
Compiled by Walter and Barbara Pilkey.
N88-18948

CP-2492 November 1987
Third Conference on Artificial Intelligence for Space Applications. Compiled by J. S.
Denton, M. S. Freeman, and M. Vereen.
N88-16360

CP-2492 June 1988
Third Conference on Artificial Intelligence for Space Applications - Part II. Compiled by J. S.
Denton, M. S. Freeman, and M. Vereen.
N88-24188

CP-3002 May 1988
A Study of Space Station Contamination Effects. Edited by M. R. Torr, J. F. Spann,
and T. W. Moorehead.
N88-25390

CP-3006 May 1988

CP-3007 August 1988
Second Conference on Artificial Intelligence for Space Applications. Compiled by Thomas Dollman.

CP-3012 August 1988
Richmond and S. T. Wu.

CP-3012 August 1988
Richmond and S. T. Wu.

CP-3013 November 1988
Fourth Conference on Artificial Intelligence for Space Applications. Compiled by S. L.
O'Dell, J. S. Denton, and M. Vereen.
CR-4103  December 1987
The Determination of Exhaust Cloud Dimensions From Films of Space Shuttle Launches. NAS8-36715. R. A. Zak, ST Systems Corp. (STX). N88-14500

CR-4114  February 1988

CR-4125  November 1987
A Study of Single and Binary Ion Plasma Expansion Into Laboratory-Generated Plasma Wakes. NAG8-058 and NAS8-31088. Kenneth Herbert Wright, Jr., Department of Physics, The University of Alabama in Huntsville. N88-18427

CR-179177  March 26, 1987

CR-179178  March 5, 1987

CR-179179  August 19, 1987

CR-179180  August 28, 1987
The Feasibility of Utilizing CCSEM, Cluster Analysis, and Fractal Analysis Techniques to Characterize and Evaluate Atmospheric Aerosols. NAS8-37313. Energy Technology Consultants. X87-10545

CR-179181  August 28, 1987
The Feasibility of Utilizing CCSEM, Cluster Analysis, and Fractal Analysis Techniques to Characterize and Evaluate Atmospheric Aerosols, Appendix. NAS8-37313. Energy Technology Consultants. X87-10546

CR-179182  December 1986

CR-179183  April 3, 1987

CR-179184  August 3, 1987

CR-179185  December 1986

CR-179186  December 1986

CR-179187  January 1986
<table>
<thead>
<tr>
<th>Contract Number</th>
<th>Date</th>
<th>Title</th>
<th>Authors/Institutions</th>
<th>Report Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR-179188</td>
<td>June 1987</td>
<td>Evaluation of Turbulent Flow in a 180 Degree Bend for Bulk Reynolds Numbers from 70,000 to 160,000.</td>
<td>Colorado State University.</td>
<td>X87-10540</td>
</tr>
<tr>
<td>CR-179202</td>
<td>March 1987</td>
<td>Space Station Mission Planning System</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)


CR-179203 March 1987

CR-179204 October 1987

CR-179205 July 20, 1987

CR-179206 1986
Pinhole Occulter Experiment. NAS8-36101. Honeywell. N88-11481

CR-179207 September 1987

CR-179208 November 1987

CR-179209 August 23, 1987
The Use of Variational Principles in Improving CFD Methodology. NAS8-37304. SECA, Inc. X88-90402

CR-179210 November 1987

CR-179211 July 1987

CR-179212 July 21, 1987

CR-179213 August 1987

CR-179214 November 1987

CR-179215 July 9, 1987

CR-179216 November 1987

CR-179217 November 1, 1987

CR-179218 September 30, 1987
Analytical Investigation of the Dynamics of
Tethered Constellations in Earth Orbit (Phase II) Quarterly Report No. 10. NAS8-36606. Smithsonian Institution. N88-12533

CR-179219 November 1987

CR-179220 September 30, 1987

CR-179221 September 1987

CR-179222 November 1987

CR-179223 May 1987

CR-179224 December 1987

CR-179225 December 1987
Carbon Dioxide Observational Platform System (Co-Op) Feasibility Study. NAS8-36600. Lockheed-Georgia Co. N88-14113

CR-179226 December 3, 1987

Universities Space Research Association. N88-90135

CR-179227 October 30, 1987

CR-179228 June 1986

CR-179229 June 1986

CR-179230 October 15, 1987

CR-179231 January 1988
Failure Control Techniques for the SSME Phase II. Final Report. NAS8-36305. Rockwell International. X88-10096

CR-179232 October 28, 1987

CR-179233 January 1987
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-179234 January 1987
N88-90001

CR-179235 November 6, 1987
X88-10074

CR-179236 May 31, 1986
Partial Analysis of Experiment LDEF A-0114. NAS8-36645. The University of Alabama in Huntsville.
N88-14787

CR-179237 October 1987
N88-14493

CR-179238 October 10, 1986
X88-10077

CR-179239 December 8, 1987
N88-14575

CR-179240 December 30, 1987
Analysis of Internal Flows Relative to the Space Shuttle Main Engine - Final Report. NAS8-35984. Lockheed Missiles and Space Co., Inc.
N88-14125

CR-179241 December 1986
N88-15021

CR-179242 August 15, 1987
X88-10072

CR-179243 May 30, 1987
N88-14380

CR-179244 March 31, 1986
Space Station Accommodations for Life Sciences Research Facilities - Phase A Conceptual Design and Programmatic Studies for Missions SAAX0307, SAAX0302, and the Transition from SAAX0307 to SAAX0302, Final Report, Volume II Study Results. NAS8-35472. Lockheed Missiles and Space Co., Inc.
N88-15829

CR-179245 December 1987
N88-15836

CR-179246 December 1987
N88-15895

CR-179247 November 30, 1987
Space Transportation Architecture Study Special Report - Final Phase Book 1 Executive Summary. NAS8-36615. General Dynamics.
X88-10247

CR-179248 November 20, 1987
Space Transportation Architecture Study Special Report - Final Phase Book 2 Trade
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-179249 November 30, 1987
Space Transportation Architecture Study
Special Report - Final Phase Book 3 Final
Phase Study Tasks. NAS8-36615. General Dynamics.
X88-10249

CR-179250 November 30, 1987
Space Transportation Architecture Study
Special report - Final Phase Book 4, Architecture
X88-10250

CR-179251 November 30, 1988
Space Transportation Architecture Study
Special Report - Final Phase Book 5 Appendices. NAS8-36615. General Dynamics.
X88-10251

CR-179252 July 10, 1987
Space Transportation Architecture Study
Special Report - Interim Study Results
Volume 1 Executive Summary. NAS8-36615. General Dynamics.
X88-10242

CR-179253 July 10, 1987
Space Transportation Architecture Study
Special Report - Interim Study Results
Volume 2 - Data Book, Book 1. NAS8-36615. General Dynamics.
X88-10243

CR-179254 July 10, 1987
Space Transportation Architecture Study
Special Report - Interim Study Results
Volume 2 - Data Book, Book 2. NAS8-36615. General Dynamics.
X88-10244

CR-179255 July 10, 1987
Space Transportation Architecture Study
Special Report - Interim Study Results
X88-10245

CR-179256 July 10, 1987
Space Transportation Architecture Study
Special Report - Interim Study Results
X88-10246

CR-179257 July 1987
Space Transportation Architecture Study
(STAS) Special Report, Interim Study Results (CDRL 021A2), Executive Summary.
NAS8-36618. Martin Marietta.
X88-10252

CR-179258 July 1987
Space Transportation Architecture Study
(STAS) Special Report Interim Study Results
(CDRL 021A2), Data Book. NAS8-36618. Martin Marietta.
X88-10258

CR-179259 July 1987
Space Transportation Architecture Study
(STAS) Special Report Interim Study Results
(CDRL 021A2), Data Book Appendices.
NAS8-36618. Martin Marietta.
X88-10253

CR-179260 October 8, 1987
Space Station Propulsion Technology
- Second Annual Progress Report May 24,
N88-15835

CR-179261 October 1986
Space Station Structures Development.
NAS8-36421. Rockwell International.
N88-16792

CR-179262 December 1987
N88-16620

CR-179263 December 1986
Feasibility Study of a Carbon Dioxide Observational Platform System, Volume II.
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

Programmatics. NAS8-36600. Lockheed-Georgia Co.

CR-179264 February 1988

CR-179265 October 26, 1987

CR-179266 January 28, 1988

CR-179267 March 31, 1986
Accommodations for Life Sciences Research Facilities - Volume I. Executive Summary. NAS8-35472. Lockheed Missiles and Space Co. N88-19571

CR-179268 October 1985

CR-179269 October 1985

CR-179270 November 1, 1985

CR-179271 October 1985

CR-179272 October 1985

CR-179273 October 1985

CR-179274 October 1985

CR-179275 June 1987

CR-179276 June 1987

CR-179277 August 1987
Application of Satellite Data in Observational and Theoretical Studies of the Evolving
Structure of Baroclinic Waves, Final Report.  
NASA CONTRACTOR REPORTS  
(NAS8-34903. Yale University.  N88-18091)

CR-179278  December 1987  
Booster Propulsion/Vehicle Impact Study,  
Progress Report IV.  NAS8-36944. Boeing  
Aerospace Co.  
X88-10098

CR-179279  December 11, 1987  
Main Chamber Combustion and Cooling  
Technology Study.  NAS8-36167. Aerojet  
Techsystems Co.  
X88-91158

CR-179280  December 1987  
Bearing Tester Data Compilation Analysis,  
and Reporting and Bearing Math Models  
Annual Report.  NAS8-36183. SRS Techno-

cologies.  
X88-10102

CR-179281  December 16, 1987  
Space Station Integrated Wall Damage and  
Penetration Damage Control Final Report,  
Task 5.  NAS8-36426. Boeing Aerospace Co.  
N88-17688

CR-179282  December 1987  
Final Report for the Long Life Fluid Systems  
X88-10097

CR-179283  March 30, 1988  
Adaptive Rigid Body Control for an Evolving  
Space Station - Final Report.  NAS8-36422.  
Ford Aerospace Corp.  
X88-10187

CR-179284  January 1988  
Carbon Deposition Model for Oxygen-
Hydrocarbon Combustion.  NAS8-34715.  
Aerojet TechSystems Co.  
X88-10189

CR-179285  January 25, 1988  
Duct Flow Nonuniformities - Effect of Struts  
in SSME HGM II+.  Interim Report.  NAS8-  
37359. Lockheed Missiles and Space Co.  
N88-22296

CR-179286  December 1987  
Lightning Data Study in Conjunction with  
Geostationary Satellite Data.  Final Report,  
June 23, 1984 to December 22, 1987.  NAS8-  
35981. Space Science and Engineering Cen-
X88-10323

CR-179287  February 1988  
Report of the Joint CSIRO/NASA Study  
Optical Properties of Southern Hemisphere  
Coherent Technologies, Inc.  
N88-21605

CR-179288  September 1987  
Solid Rocket Motor Alt Field Joint Flow  
Scientific Research Associates, Inc.  
N88-24675

CR-179289  December 1987  
A Finite Element Solver for 3-D Compress-
ible Viscous Flows.  NAS8-36555. The  
University of Tennessee Space Institute.

CR-179290  May 1988  
Atmospheric Science and Remote Sensing  
Laboratory, Annual Report.  NAS8-36279.  
The University of Alabama in Huntsville.  
N88-23355

CR-179291  March 28, 1988  
Microgravity and Materials Processing  
Facility Study (MMPF) - Requirements and  
Analyses of Commercial Operations (RACO)  
Preliminary Data Release.  NAS8-36122.  
Teledyne Brown Engineering.

CR-179292  December 15, 1987  
Improved Internal Ballistic Analysis and  
Design Procedures for Solid Rocket Motors.  
X88-10097
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CR-179307</td>
<td>December 22, 1987</td>
<td>High Performance Solid Rocket Motor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23

CR-179308 February 1988

CR-179309 March 3, 1988

CR-179310 August 1987
Design Definition Document for the Space Transportation Main Engine Phase A Study. NAS8-36869. Rockwell International. X88-10125

CR-179311 October 1987

CR-179312 February 27, 1987

CR-179313 February 1988
Booster Propulsion/Vehicle Impact Study-II. NAS8-36945. Martin Marietta. X88-10126

CR-179314 October 15, 1987

CR-179315 December 9, 1987

CR-179316 February 1988

CR-179317 February 1988

CR-179319 February 1988

CR-179320 February 1988

CR-179321 July 1987

CR-179322 January 1988

CR-179323 February 9, 1987
Space Station Contamination Control Study, Final Report for Phase I, Internal Contamination. NAS8-36432. Boeing Aerospace Co. X88-10124
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-179324  March 1988
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) Systems Study. Performance Review. NAS8-37136. Martin Marietta. X88-10127

CR-179325  September 30, 1985

CR-179326  December 1986

CR-179327  February 1987

CR-179328  April 1987
Elementary and Middle School Science Improvement Project. NAS8-36277. Alabama A&M University. N88-23679

CR-179329  November 1987
Space Transportation Architecture Study (STAS) Book 1 Executive Summary. NAS8-36618. Martin Marietta. X88-10257

CR-179330  November 1987
Space Transportation Architecture Study (STAS) Book 2 - Trade Studies. NAS8-36618. Martin Marietta. X88-10256

CR-179331  November 1987
Space Transportation Architecture Study (STAS) Book 3 - Final Phase Study Tasks. NAS8-36618. Martin Marietta. X88-10259

CR-179332  November 1987
Space Transportation Architecture Study (STAS) Book 4 - Design Requirements.

CR-179333  November 1987
Space Transportation Architecture Study (STAS) Book 5 - Appendices. NAS8-36618. Martin Marietta. X88-10254

CR-179334  April 1988

CR-179335  October 1987

CR-179336  April 1, 1988

CR-179337  May 2, 1988

CR-179338  December 30, 1987

CR-179339  May 1988

CR-179340  May 1988
Utilization of the IR Telescope Gimbaling
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)


CR-179341 February 10, 1988

CR-179342 April 1988

CR-179343 March 1988

CR-179344 June 1988

CR-179345 January 6, 1988

CR-179346 November 30, 1987

CR-179347 April 5, 1987

CR-179348 March 9, 1987

CR-179349 October 1987

CR-179350 June 1987

CR-179351 October 1987

CR-179352 January 6, 1988
Space Transportation Main Engine (STME) Configuration Study - Quarterly Review. NAS8-36867. Aerojet TechSystems Co. X88-10368

CR-179353 May 1987
Environmental Analysis for the Space Transportation Main Engine. NAS8-36869. Rockwell International. X86-10262

CR-179354 May 12, 1988

26
<table>
<thead>
<tr>
<th>Contract No.</th>
<th>Date</th>
<th>Title</th>
<th>Authors/Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR-179371</td>
<td>July 1988</td>
<td>Analytical Investigation of the Dynamics of Tethered Constellations in Earth Orbit (Phase</td>
<td>27</td>
</tr>
</tbody>
</table>

CR-179372 May 19, 1987

CR-179373 June 1987

CR-179374 May 1987

CR-179375 September 1987

CR-179376 September 1987

CR-179377 July 1988

CR-179378 July 26, 1988

CR-179379 July 31, 1987

CR-179380 September 14, 1987

CR-179381 August 1987

CR-179382 October 1987

CR-179383 September 1987

CR-179384 September 4, 1987

CR-179385 September 8, 1987

CR-179386 August 28, 1987

CR-179387 August 15, 1987
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-179388 July 1987
Portable Low Temperature Cooler for Space Station, Final Report. NAS8-37317. SRS Technologies.

CR-179389 August 1988

CR-179390 August 1988

CR-179391 July 19, 1988
A Computer-Aided Approach to Nonlinear Control Synthesis. NAS8-36224. The University of Texas at Austin. N88-28673

CR-179392 November 1986

CR-179393 August 25, 1988

CR-179394 August 1987

CR-179395 September 23, 1987

CR-179396 March 1, 1988
Space Transportation Main Engine Reduced-Cost Configuration Study. NAS8-36868. United Technologies Pratt & Whitney.

CR-179397 July 1988
GUO, J.                             ADENIJI-FASHOLA, A. A.  (NRC) ED42
CARLI, B.                          OYEDIRAN, A. A.
CARLOTTI, M.                  ADENIJI-FASHOLA, A. A.  ED42
                                CHEN, C. P.

GUO, J.                             ADENIJI-FASHOLA, A. A.  ED42
CARLI, B.                          CHEN, C. P.
CARLOTTI, M.                                           ADENIJI-FASHOLA, A. A.
NOLT, I. G.                                           ED42

ABBAS, M. M.                         ES55
et al.                             CHEN, C. P.


ADELFANG, S. I.                        ED44
SMITH, O. E.                     AGRAWAL, P. C.  ES65
BATTIS, G. W.                                       RAMSEY, B. D.
HILL, C. K.                                         Use of Propane as a Quench Gas in Argon Filled Proportional Counters and Comparison with Other Quench Gases. For publication in Nuclear Instruments and Methods in Physics Research, Amsterdam.


ADENIJI-FASHOLA, A. A.  (NRC) ED42
CHEN, C. P.
Particle Trajectory Modeling of Mixing in Confined Turbulent Two-Phase Flows. For presentation at the 5th Miami International Symposium on Multi-Phase Transport and
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Date</th>
<th>Title</th>
<th>Conference/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAIYDA, J.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAIYDA, J.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUSIELAK, Z. E.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOORE, R. L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUESS, S. T.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUESS, S. T.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WU, S. T.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AN, C.-H.</td>
<td>ES52</td>
<td>MHD simulations for Quiescent Prominence Formation by Photospheric Shearing or Converging Motions.</td>
<td>For publication in the Proceedings of the Workshop on Dynamics and Structure of Solar Prominences, Palama de Mallorca, Spain.</td>
</tr>
<tr>
<td>WU, S. T.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAO, J. J.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUESS, S. T.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLEMAN, ARCHIE D.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRISKILL, TIMOTHY D.</td>
<td>ET53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLEMAN, ARCHIE D.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FONTENLA, J. M.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MILLER, JIMMY L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEISGANG, TOM (LMSC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MILLER, JIMMY L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEISGANG, TOM (LMSC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MILLER, JIMMY L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BENTON, E. V.</td>
<td>ES62</td>
<td>Space Radiation Dosimetry on U.S. and Soviet Manned Missions.</td>
<td>For publication in Terrestrial Space Radiation and Its Biologi-</td>
</tr>
</tbody>
</table>
BERTERO, G. A. ES74
HOFMEISTER, W. H.
BAYUZICK, R. J.
ROBINSON, M. B.

BILBRO, JAMES W. EB23
Cryogenic Turbopump Bearing Materials. For presentation at the AGARD 72nd-A Specialists Meeting on Application of Advanced Material for Turbomachinery and Rocket Propulsion, Bath, United Kingdom, October 3-5, 1988.

BILBRO, JAMES W. EB23

BILBRO, JAMES W. EB23

BLACKWELL, DOUGLAS EP55
Statistical Correlations Between Burn Rate and Other Variables in Shuttle SRM Propellant. For presentation at the Third Annual AIAA (Solid Rocket Technical Committee) SRTC Lecture Series, Reno, Nevada, January 13-14, 1988.

BLAKESLEE, RICHARD J. ED43
Electrical Measurements over Active Thunderstorms. For presentation at the 8th International Conference on Atmospheric Electricity, Uppsala, Sweden, June 13-16, 1988.

BLAKESLEE, RICHARD J. ED43

BROOK, M. B. ES76
WITHEROW, W. K.
SNYDER, R. S.
CARTER, D. C.

BROWN, NORMAN S. PD22

BURNS, ROWLAND E. EL23

BUTLER, JOHN M., JR. PS04

CAHILL, L. J., JR. ES53
WAITE, J. H., JR. et al.
CAMPINS, HUMBERTO  
LIEN, D. J.  
DECHER, R.  
TELESCO, C. M.  
CLIFTON, K. S.  


CARLSON, CATHERINE  

A Case Study Using Kinematic Quantities Derived from a Triangle of Doppler Wind Profilers. For publication in Journal of Atmospheric and Oceanic Technology, Boulder, Colorado.

CARLSON, CATHERINE  


CARRASQUILLO, ROBYN  

WAGNER, ROY  
EDWARDS, JIM  

Life Systems Inc.  
Boeing Aerospace  


CARTER, JAMES A.  


CHAPPELL, CHARLES R.  

The Terrestrial Plasma Source - A New Perspective in Solar Terrestrial Processes from Dynamics Explorer. For publication in Review of Geophysics and Space Physics, Washington, D.C.

CHAPPELL, CHARLES R.  


CHEN, C. P.  

SCHAFER, C. F.  


CHENG, A. F.  

WAITE, J. H., JR.  


CHOU, LYNN C.  


CHOU, SHAH-HUNG  

LOESCH, ARTHUR Z. (NRC)  

Effect of Topography on Supercritical Baroclinic Disturbances. For presentation at the Palmen Memorial Symposium, Helsinki, Finland, August 29-September 2, 1988.

CHRISTIAN, HUGH J., JR.  


CHRISTIAN, HUGH J., JR.  

Optical Observations of Lightning from a U-2 Aircraft. For presentation at the 8th International Conference on Atmospheric
CHRISTIAN, HUGH J., JR. ED43
The Detection and Location of Lightning from Geostationary Orbit. For presentation at the Third Conference on Satellite Meteorology and Oceanography, Anaheim, California, January 31-February 5, 1988.

CHRISTIAN, HUGH J., JR. ED43

CLARK, KEITH H. EB24
HARMAN, HARLAN S.

COATES, KEITH DAVIS, MOODY EE51

COATES, K. D. SMITH, J. D.
ALDRIDGE, L. L. (Martin Marietta) EE51
HEIDEMANN, W. B.
LANGHENRY, M. T.
MURPHY, J. M.

COBB, S. D. ES75
SZOFRAN, F. R.
LECHOZKY, S. L.
Growth Rate Dependence of the Radial Segregation in Directionally Solidified Hg Cd Te Alloys. For presentation at the AACG/West Tenth Conference on Crystal Growth, Stanford Sierra Camp, Fallen Leaf Lake, California, June 7-10, 1988.

COLEMAN, SANDRA C. BATSON, ROBERT G. ES53
Federal Incentives for Industrial Modernization: Historical Review and Future Opportunities. For publication in Engineering Economist.

COMFORT, R. H. CRAVEN, P. D. ES53
et al.
Spacecraft Potential Effects on Measurements of Ion Depletion in the Wake. For presentation at the 1988 Fall Meeting, American Geophysical Union, San Francisco, California, December 5-9, 1988.

COMFORT, R. H. COSTA, A.
CRANJE, J. M.
RINGUELET, A. E.
Oscillations in Stellar Atmospheres. For publication in Astrophysics Letters, Great Britain.

CROFT, F. MAX AT01
LEDBETTER, WILLIAM N.
CURRERI, P. A. ES74
STEFANESCU, D. M.
Low-Gravity Effects During Solidification.
For publication in ASM International, Metals Park, Ohio.

CURRERI, P. A. ES73
LEE, J. E.
STEFANESCU, D. M.

CURRERI, P. A. ES74
LARSON, D. J.
STEFANESCU, D. M.

DABBS, JOSEPH R. PS02
DAVIS, BILLY
DAVIS, JOHN

DAVIS, J. M. ES52
WEISSKOPF, M. C.
HUDSON, H. S.
HURFORD, G. J.

DEATON, ALVA W. EL23
UPADHYAY, TRIVENI
RHODEHAMEL, HARLEY

DECHER, R. ES61
TELESCO, C. M.
GOLISCH, W. F.
CAMPINS, H.

DECHER, R. ES61
TELESCO, C. M.
SISK, C.
CAMPINS, H.

DeJONG, F. ED32
SABNIS, J.
McCONNAUGHEY, P.

DELCOURT, D. C. (NRC) ES53
MOORE, T. E.
et al.

DELCOURT, D. C. ES53
MOORE, T. E. et al.

DELCOURT, D. C. ES53
MOORE, T. E. et al.
Polar Wind Ion Bands After Neutral Sheet Acceleration. For publication in the Journal Geophysical Research, Washington, D.C.

DELCOURT, D. C. ES51
HORWITZ, J. L. (NRC)
SWINNEY, K. R. (NAS)

DERRICKSON, J. H. ES62
EBY, P. B.
FOUNTAIN, W. F.
PARNELL, T. A.
ROBERTS, F. E.
WATTS, J. W., JR. et al.

DHINDAW, B. K. ES74
MOITRA, A.

STEFANESCU, D. M.
CURRELLI, F. A.
Directional Solidification of Al-Ni/SlC Composites During Parabolic Trajectories. For publication in Metallurgical Transactions, Pittsburgh, Pennsylvania.

DHINDAW, B. K. ES74
STEFANESCU, D. M.
SINGH, A. K.
CURRELLI, P. A.
Solidification Behavior of Cu-Pb and Bi-Ga Monotectic Alloys During Ground and Parabolic Flight Processing. For publication in Metallurgical Transactions, Pittsburgh, Pennsylvania.

DOUGANI, H. ES51
TORR, D.
HARRISON, D.
TORR, M. R.
Ca⁺ Emission in the Sunlit Ionosphere. For presentation at the 1988 Spring Meeting American Geophysical Union, Baltimore, Maryland, May 16-20, 1988.

DUGAL-WHITEHEAD, NORMA R. EB12
KAPUSTKA, ROBERT E.

EBISUZAKI, TOSHIKAZU ES65
TAKAHASI, YOSHIYUI
SHIBAZAKI, NORIAKI

EBISUZAKI, TOSHIKAZU ES65
SHIBAZAKI, NORIAKI
The Effects of Mixing in the Ejecta on the Hard X-ray Emission from SN1987A. For
publication in the American Astronomical Society, Washington, D.C.

EBISUZAKI, TOSHIKAZU
SHIBAZAKI, NORIAKI

EBY, P. B.
Implications of General Covariance and the Conventionality of Simultaneity for the Testing of Special Relativity. For publication in the International Journal of Theoretical Physics, Great Britain.

ELSNER, R. F.
SHIBAZAKI, N.
WEISSKOPF, M. C.
QPO Shot Noise Models for Power and Cross-Spectra, Cross-Correlation Functions, and Third Moments. For presentation at the Quasi-Periodic Oscillations in Luminous Galactic X-Ray Sources, La Cienega, New Mexico, October 2-7, 1988.

ELSNER, R. F.
SHIBAZAKI, N.
EBISUZAKI, T.
WEISSKOPF, M. C.
BUSSARD, R. W.

ESKRIDGE, RICHARD H.

FARNER, KAREN O.
CAMPBELL, JONATHAN W.


FELLows, C. W.
THEODOU LOU, I. E.
WU, M. K.
PETERS, P. N.
SISK, R. C.

FENNELLY, J. A.
TORR, D. G.
TORR, M. R.
OH A28-X2π (0,0) Band Rotational Line Emission Rate Factors. For publication in the Journal of Geophysical Research, Washington, D.C.

FERNANDEZ, KEN R.
COOK, GEORGE E.

FICHTL, GEORGE H.
HILL, C. K.
VAUGHAN, O. H.

FIKES, JOHN
NEIN, MAX
ELROD, STEVE
On-Orbit Utilization of the External Tank.
For presentation at A Symposium on Space Commercialization: Roles of Developing Countries, Nashville, Tennessee, March 5-10, 1989.

FISHMAN, G. J. ES62
PACIESAS, W. S.
GREGORY, J. C.

FISHMAN, G. J. ES62
MEEGAN, C. A.
WILSON, R. B.
PACIESAS, W. S.
SANDIE, W. G.

FISHMAN, G. J. ES62
INAN, U. S.

FONTENLA, J. M. ES52
FONTAN, C. FERRO
ROVIRA, M.
Radiation and Particle Transport II. Partially Ionized Hydrogen. For publication in Astronomy and Astrophysics, Great Britain.

FONTENLA, J. M. ES52
Radiation and Particle Transport I. Partial NLTE Formulation. For publication in Astronomy and Astrophysics, Great Britain.

TANDBERG-HANSSSEN, E.
REICHMANN, E.
FILIPOWSKI, S.

FONTENLA, J. M. ES52
MOORE, R. L.

FONTENLA, J. M. ES52
TANDBERG-HANSSSEN, E.

FOWLIS, W. W. ES76
KORNFELD, D. M.
ROBERTS, G. O.

FRAZIER, D. O. ES75
FACEMIRE, B. R.
tion of a Miscibility Gap Type System: Succinonitrile-Water. For publication in Metallurgical Transactions, Pittsburgh, Pennsylvania.


FRY, CYNTHIA C. Sociological Aspects of Long-Duration Manned Spaceflight. For presentation at the AIAA Meeting, Atlanta, Georgia, September 7-9, 1988.


GILL, DALE PETERS, PALMER SISK, CHARLES Requirements and an Approach for Coating the Gravity Probe B Gyroscope Rotor. For presentation at the 15th International Conference on Metallurgical Coatings (ICMC 88), San Diego, California, April 11-15, 1988.

GOODMAN, MICHAEL H. (UAH)
PARKER, KAREN G. (NTI)
KARITANI, SHOGO (NTI)
STOOKSBURY, LAURA M. ED44
WILSON, GREGORY S. ED41


GOODMAN, STEVEN J. ED44
BUECHLER, DENNIS E.
WRIGHT, PATRICK D.
RUST, W. DAVID

Lightning and Precipitation History of a Microburst-Producing Storm. For publication in Geophysical Research Letters, American Geophysical Union, Washington, D.C.

GOODMAN, STEVEN J. ED43
CHRISTIAN, H. J.
RUST, W. D.

A Comparison of the Optical Pulse Characteristics of Intracloud and Cloud-to-Ground Lightning as Observed Above Clouds. For publication in Journal of Applied Meteorology, AMS, 45, Boston, Massachusetts.

GOODMAN, STEVEN J. ED43
BUECHLER, DENNIS E.
WEBER, MARK E.


HAGYARD, MONA J. ES52

HAGYARD, MONA J. ES52
Flare Onset at Sites of Maximum Magnetic Shear. For presentation at the AAS Solar Physics Division Meeting and MAX'91 Workshop, Kansas City, Missouri, June 5-10, 1988.

HAGYARD, MONA J. ES52

HAMAKER, JOSEPH W. PP03
PATEL, SAROJ


HAN, S. S. ED42
SCHAFFER, C. F.


HARRINGTON, MICHAEL M. TA41

Hubble Space Telescope Orbital Verifica-
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

HARRIS, LOWELL D.
GUPTA, NAND K.
SMITH, CHARLES R.
BERNARDI, RICHARD T.
MOORE, JOHN F.
HEDIGER, LISA

HARRISON, JAMES K.

HATHAWAY, DAVID H.

HATHAWAY, DAVID H.

HATHAWAY, DAVID H.
Simulating Photospheric Doppler Velocity Fields. For publication in Solar Physics, Boston, Massachusetts.

HEAMAN, JOHN P.

HEDIGER, LISA

HERRMANN, MELODY C.

HICKEY, M.
JOHNSON, D.
SMITH, R.
Comparisons of the MSFC/70 and CIRA 1986 Thermospheric Models at Shuttle (230 km) and Tethered Satellite (130 km) Altitudes: Molecular Oxygen and Total Densities. For presentation at the 26th Aerospace Sciences Meeting AIAA, Reno, Nevada, January 11-14, 1988.

HILL, KELLY

HIXSON, JEFF
RIECKHOFF, THOMAS

HOFMEISTER, W.
BAYUZICK, R. J.
ROBINSON, M. B.
Non-Contact Temperature Measurement of a Falling Drop. For presentation at ASME.
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

10th Symposium on Thermophysical Properties, NBS, Gaithersburg, Maryland, June 20-23, 1988.

HOOD, ROBBIE E. SPENCER, ROY W.
Thunderstorm Ice Induced Brightness Temperature Depressions at 18, 37, and 92 GHz During COHMEX and Their Implications for Satellite Precipitation Retrievals. For presentation at the Third Conference on Satellite Meteorology and Oceanography, Anaheim, California, January 31-February 5, 1988.

HOOVER, RICHARD B. et al.
Solar X-Ray/XUV Imagery with Kodak T-Max 100 Film. For publication in Kodak Tech Bits, Rochester, New York.

HOOVER, RICHARD B. et al.

HOWARD, RICHARD T. DABNEY, RICHARD W.
Development of a Video-Based Automatic Rendezvous and Docking System. For presentation at the Society of Manufacturing Engineers, Anaheim, California, February 1989.

HOWELL, LEONARD W., JR.

HUANG, C. Y. SHAPIRA, Y. McNIFF, E. J., JR.

HUANG, C. Y. SHAPIRA, Y.

HUMPHRIES, WILLIAM R.
Presentation Material to International Space University at MIT. For presentation at the International Space University, Boston, Massachusetts, July 19, 1988.

HUMPHRIES, WILLIAM R.

HUNG, R. J. TSAO, Y. D. HONG, B. B.

HUANG, C. Y. SHAPIRA, Y. McNIFF, E. J., JR.

42
HONG, B. B.  
LESLIE, FRED W.  

HUNG, R. J.  
TSAO, Y. D.  
HONG, B. B.  
LESLIE, FRED W.  
Dynamics of Surface Tension in Microgravity Environment. For presentation at the Space Commercialization: Roles of Developing Countries, Nashville, Tennessee, March 5-10, 1989.

HUNG, R. J.  
TSAO, Y. D.  
HONG, B. B.  
LESLIE, FRED W.  

HUNG, R. J.  
TSAO, Y. D.  
JOHNSON, D. L.  
CHEN, A. J.  
LIN, C. H.  
CHENG, J. M.  
YOU, C. M.  

 JAAP, JOHN P.  
DAVIS, ELIZABETH K.  

JEDLOVEC, GARY J.  
YOU, C. M.
JOHNSON, DALE L. ED44

JONES, CLYDE S. EH42
Welding Automation Development at the Marshall Space Flight Center. For presentation at the Advances in Automation for Precision Arc Welding - Edison Welding Institute, Columbus, Ohio, December 2-3, 1987.

JONES, STEVEN R. EE63
OMV Teleoperation and Video Data Compression. For presentation at Scientific Data Compression Workshop, Snowbird, Utah, May 3-5, 1988.

JOY, MARSHALL ES65
LESTER, DANIEL F.
HARVEY, PAUL M.
TELESCO, CHARLES M.
DECHER, RUDOLF
RICKARD, LEE J.

BUSHOUSE, HOWARD

KANNAPEL, M. D. ED42
PREZKWAS, A. J.
SINGHAL, A. K.
COSTES, N. C.


KAPUSTKA, ROBERT E. EB12
KOCH, D. G. ES63
MELNICK, G. J.
FAZIO, G. G.
RIECKE, G. H.
LOW, F. J.
HOFFMANN, W.
YOUNG, E. T.
URBAN, E. W.
SIMPSON, J. P.
WITTEBORN, F. C.
GAUTIER, T. N., III
POTEET, W.


KROES, R. L.
REISS, D. A.
ANDERSON, E. E.


LANIER, JOHN R.

HST EPS Simulation Breadboard. For publication in IECEC '87 Proceedings, August 1987.

LEE, JAMES E.
THWARI, S. N.
CURRELL, P. A.


LI, PENG
WILSON, G. R.
MOORE, T. E.
et al.

Effect of Low Altitude Ion Heating on Ion Outflow at Polar Latitudes. For publication in JGR, Washington, D.C.

LINDBLOM, JOAKIM F.

HOOVER, RICHARD B.
et al.


LOLLAR, LOUIS F.
WEEKS, DAVID J.


LOLLAR, LOUIS F.
KAPUSTKA, ROBERT E.

Minimizing the Total Harmonic Distortion for a 3kW, 20kHz AC to DC Converter Using SPICE. For presentation at the IECEC '88, Denver, Colorado, July 31-August 5, 1988.

LOMBARDO, JOSEPH A.


LOO, B. H.
WU, M. K.
BURNS, D. H.
IBRAHIM, A.
ROLIN, T.
LEE, Y. G.
FRAZIER, D. O.
ADAR, F.

McCONNAUGHEY, HELEN V. ED32

McCONNAUGHEY, P. CORNELISON, J. W. BARKER, L.

McCONNAUGHEY, PAUL K. ED32

McCONNAUGHEY, PAUL K. ED32

McCONNAUGHEY, HELEN V. McCONNAUGHEY, PAUL K.

McCOOL, A. A. CR01

McKANNAN, E. C. EH01

McKEE, JAMES W. WOLFSBERGER, JOHN W.
A Graphical, Rule-Based Robotic Interface System. For presentation at the Fourth Conference on Artificial Intelligence for Space Application, Huntsville, Alabama, November 1988.

MENIETTI, J. D. GALLAGHER, D. L. et al.
Statistical Study of Ion Flows in the Dayside and Nightside Outer Plasmasphere. For publication in Planetary and Space Sciences, Washington, D.C.

MEYER, PAUL J. SEABLOM, MICHAEL S. (USRA)
Application of the Four-Dimensional McIDAS to LAMPS Model Output. For presentation at the Fourth International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, Anaheim, California, February 1-5, 1988.

MILLER, E. R. MILLER, E. R. CLIFTON, K. S.

MILLER, E. R. CLIFTON, K. S.
Space Station Particulate Contamination Environment. For publication in the Proceedings of the Space Station Contamination Workshop.
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

MITCHELL, TERRY R. PF24

MONSON, D. J. ED32
SEEGMILLER, H. L.
KWAK, D.
McCONNAUGHEY, P. K.
ROCKER, M.

MOORE, CARLETON J. ED22

MOORE, RONALD L. ES52

MOORE, R. L. ES52
MUSIELAK, Z. E.

MOORE, RONALD L. ES52

MOORE, R. L. ES52
HAGYARD, M. J.
DAVIS, J. M.

MOORE, T. E. ES53
et al.

MOORE, T. E. ES53
et al.

MOORE, T. E. ES53
et al.
Reply to Lanzerotti and Uberoi. For publication in Geophysical Research Letters, Washington, D.C.

MOORE, T. E. ES53
WAITES, J. H., JR.
POLLOCK, C. J.
CHANDLER, M. O.
CHAPPELL, C. R.
GURNETT, D.
Upwelling Ion Plasma Characteristics: A Statistical Study. For presentation at the

MOREA, SAVERIO F. ER01

MORGAN, SAMUEL PS02
PAIK, HO JUNG
LEUNG, JURN-SUN
PARKER, JOSEPH

MORRONI, CHERYL A. ED42

MULQUEEN, JOHN A. PD32

MUSIELAK, Z. E. ES52

MUSIELAK, Z. E. ES52
SUSS, S. T.

PACIESAS, W. S. ES62
PENDLETON, G. N.
WILSON, R. B.
FISHMAN, G. J.
MEEGAN, C. A.

PACIESAS, W. S. ES62
GREGORY, J. C.
FISHMAN, G. J.

PEARSON, JEROME ED12
WAITES, HENRY

PERRY, J. EL84
HUMPHRIES, W. R.

PETERS, P. N. ES63
SISK, R. C.
URBAN, E. W.
HUANG, C. Y.
WU, M. K.

PETERS, P. N. ES63

PETERS, P. N. ES63

PETERS, P. N. ES63

PETERSON, W. K. ES53
MOORE, T. E.

PETERSON, W. K. ES53
MOORE, T. E.
et al.

POLITES, MICHAEL E. ED12

POLITES, MICHAEL E. ED12

POLLOCK, C. J. (NRC) ES53
MOORE, T. E.
et al.
Observations of Electric and Magnetic Field Signatures in Association with Upwelling Ion Events. For presentation at the 1988 Fall Meeting American Geophysical Union, San Francisco, California, December 5-9, 1988.

PORTER, J. G.
MOORE, R. L.
MOORE, R. L.
REICHMANN, E. J.
FONTENLA, J. M.
Detection of Microflares with the Present UVSP. For presentation at the American Astronomical Society Solar Physics Division Meeting and MAX '91 Workshop, Kansas City, Missouri, June 5-10, 1988.

PORTER, J. G.
MOORE, R. L.
Recent Observations of Solar Microflares. For presentation at the 1988 Spring Meeting, American Geophysical Union, Baltimore, Maryland, May 16-20, 1988.

POWERS, W. T.
SHERRELL, FRED
AEDC

PRICE, JOHN M.
WEISSKOPF, M. C.
AGRAWAL, P. C.
The Effects of Contamination on Gaseous X-ray Detectors. For publication in Nuclear Instruments and Methods in Physics Research - A, Amsterdam, Holland.

REASONER, DAVID L.
Plasma Perturbations Produced by the Interaction Between the Shuttle Orbiter and the Flowing Ionosphere. For presentation at the 1988 Fall Meeting American Geophysical Union, San Francisco, California, December 5-9, 1988.

REDMON, JOHN W., SR.
Space Shuttle, Solid Rocket Motor Profile Measuring Device. For presentation at the 22nd Aerospace Mechanisms Conference, NASA. Langley Research Center, May 4-6, 1988.

REED, DARREN
NESMAN, TOM
HOWARD, PAUL

REILY, JACK C.

REUTER, J. L.
TURNER, L. D.
HUMPHRIES, W. R.

RHODES, P. H.
SNYDER, R. S.
ROBERTS, G. O.
Electrohydrodynamic Distortion of Sample Streams in Continuous Flow Electrophoresis. For publication in the Journal of Colloid and Interface Science, Potsdam, New York.

RICE, S. C.
JONES, V. L.
WAITES, H. B.

RICHMOND, ROBERT J.

RIVES, T. B.
ingels, F.
SETTLE, G.
JOBE, S.

ROBERTSON, FRANKLIN R.
PERKEY, DONALD (Drexel University)
SEABLOM, MICHAEL (USRA)

ROBERTSON, FRANKLIN R.
Vertical Profiles of Heating Derived from IR-Based Precipitation Estimates During

RONAN, R. ES51
MICKEY, D.
ORRALL, F.
WEST, E. A.
HAGYARD, M. J.

ROSNER, R. ES52
MUSIELAK, Z. E.
Generation of MHD Waves by Forced Turbulence. For publication in Astronomy Astrophysics Letters, Great Britain.

ROSNER, R. ES52
MUSIELAK, Z. E.

RUPP, CHARLES C. PS04

RUSSELL, KENNETH C. ES74
SHIOHARA, YUH
FRIER, NANCY L.
CURRERI, P. A.

SAFIE, FAYSSAL M. CT13

SAFIE, FAYSSAL M. CT13

SAMIR, U. ES53
STONE, N. H.
et al.

SAUCIER, SIDNEY P. FA01

SCHAFER, C. F. ED42
MORRONI, C. A.
Characterizing the Acceleration Environment of a Fluids or Materials Processing Space Experiment. For presentation at the AIAA 27th Aerospace Sciences Meeting, Reno, Nevada, January 8-12, 1989.

SCHMIEDER, B. ES01
SIMNETT, G. M.
TANDBERG-HANSSEN, E.
MEIN, P.
An Example of the Association of X-Ray and UV Emission with Hα Surges. For publication in Astronomy and Astrophysics, Meudon, France.
TANDBERG-HANSSEN, E.
et al.
Surges as Tracers of Magnetic Lines. For publication in Proceedings 10th European Regional Astronomy Meeting of the IAU. The Netherlands.

SCHROER, BERNARD J.
TSENG, FAN T.
DWAN, W. S.
WOLFSBERGER, JOHN W.

SCHWANGARTNER, ARTHUR J., JR.

SCHWINGHAMER, R. J.

SCHWINGHAMER, R. J.
National Aeronautics and Space Administration Advanced Manufacturing Review. For presentation at the IRI/FLC Advanced Manufacturing Seminar, Dayton, Ohio, March 30, 1988.

SCOTT, H. A.
O’DELL, S. L.

SEAL, ELLIS
HACKETT, ROBERT
GORDON, GAIL H.

SELIG, W. J.
SLATER, P. J.

SELIG, WILLIAM J.
JOHANNES, JAMES D.

SHARBER, J. R.
WAITE, J. H., JR.
et al.

SHIBAZAKI, N.
EBISUZAKI, T.
The Effect on the Gamma Ray Lines of Mixing of $^{56}$Ni in the Core. For publication by the American Astronomical Society, Washington, D.C.

SHIBAZAKI, N. ES65
ELSNER, R. F.
BUSSARD, R. W.
EBISUZAKI, T.
WEISSKOPT, M. C.


SHIELDS, A. W. ES75
FRAZIER, D.
PENN, B.


SHINAGAWA, H. (NRC) ES53
WAITE, J. H., JR.

The Ionospheres of Uranus and Neptune. For presentation at the 1988 Fall Meeting American Geophysical Union, San Francisco, California, December 5-9, 1988.

SIMON, G. ES01
MEIN, N.

SCHMIEDER, B.
TANDBERG-HANSSSEN, E.
WU, S. T.


SINGH, NAGENDRA (UAH) ES53
HWANG, K. S.


SMALLEY, L. L. ES65
RAY, J. R.


SNYDER, R. S.
RHODES, P. H.


SOHN, JEONG L. ED42

Evaluation of FIDAP on Some Classical Laminar and Turbulent Benchmarks. For publication in the International Journal for Numerical Methods in Fluids.

SPENCER, ROY W. ED43
GOODMAN, H. MICHAEL


SPENCER, ROY W.
GOODMAN, H. MICHAEL
HOOD, ROBBIE E.

Precipitation Retrieval over Land and Ocean with the SSM/I, Part 1: Identification and Characteristics of the Scattering Signal. For publication in the Journal of Atmospheric and Oceanic Technology.

SPENCER, ROY W. ED43

Results of MOS-1 Data Analysis. For presentation at the 2nd Symposium on MOS-1 Verification Program, Tokyo, Japan, July 12-14, 1988.
SPENCER, ROY W. ED43
Tropical Rain Systems Observed by the Nimbus 7 SRRM. For presentation at the Symposium on Tropical Rain Measurements, Tokyo, Japan, October 28-30, 1987.

STACY, KENNETH L. EL22
JAAP, JOHN P.

STEINCAMP, JAMES W. PD34

STONE, N. H. ES53
et al.

STONE, N. H. ES53
et al.
Comment on "Ram Ion Scattering by Space Shuttle V X B Induced Differential Charging." For publication in the Journal of Geophysical Research, Washington, D.C.

STONE, N. H. ES53

STONE, N. H. ES53
WRIGHT, K. H., JR.
et al.

SU, CHING-HUA ES75
LEHOCZKY, S. L.
SZOFRAN, F. R.

SUESS, S. T. ES52
MUSIELAK, Z. E.

SUESS, S. T. ES52
MUSIELAK, Z. E.

TANDBERG-HANSSEN, E. ES01

TAYLOR, WILLIAM E. TA81
HST Transportation to the Launch Site. For presentation at the Technical and Business
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)


TELESCO, C. M. ES63
BECKLIN, E. E.
WOLSTENCROFT, R. D.
DECHER, R.

TELESCO, C. M. ES63
DECHER, R.

TELESCO, C. M. ES63

TELESCO, C. M. ES63
DECHER, R.
A New Mid-IR Map of the 3 kpc IR Disk in the Seyfert Galaxy NGC 1068. For presentation at the 171st Meeting of the American Astronomical Society, University of Texas, Austin, Texas, January 10-15, 1988.

TENNANT, ALLYN F. ES65
QPO in Cir X-1 and Cen X-3. For presentation at the Quasi-Periodic Oscillations in Luminous Galactic X-ray Sources, La Cienega, New Mexico, October 2-7, 1988.

THOMAS, LAWRENCE D. EJ13

THOMAS, LINNIE EB44

THORNSON, HARLEY A. ES63
HUNTER, DEIDRE A.
TELESCO, C. M.
GREENHOUSE, MATTHEW
HARRER, D. A.

TORR, D. G. ES51
SWIFT, W.
FENNELLY, J.
DOUGANH, H.
TORR, M. R.

TORR, M. R. ES51
TORR, D. G.
EUN, J. W.
SWIFT, W.
DOUGANH, H.
HARRISON, D.

TORR, MARSHA R. ES51
The Induced Environment Around Space Station. For presentation at the XXXIXth International Astronautical Congress, Bangalore, India, October 8-15, 1988.

TRINH, HUU P. EP55
ISSAC, K. M.
CHEN, Y. S.
Numerical Study of Hydrogen-Air Mixing
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)


TSENG, FAN T. EB42
WOLFSBERGER, JOHN W.
ZHANG, S. X.

TURNER, JAMES E. EH33

VAN ALSTINE, JAMES M. ES76
Hardware for Studying the Demixing of Aqueous Polymer Two-Phase Systems in Low Gravity. For presentation at the Workshop on Microgravity Experimentation in Aircraft and Rockets, Ottawa, Canada, May 5-6, 1988.

VENKATAKRISHNAN, P. ES52
GARY, G. A.
Potential Field Calculations from Vector Magnetograms Obtained from the Center of the Solar Disk. For publication in Solar Physics, Utrecht, The Netherlands.

VENKATAKRISHNAN, P. ES52

VENKATAKRISHNAN, P. ES52
HAGYARD, M. J.
HATHAWAY, D. H.
Elimination of Projection Effects from Vector Magnetograms: The Pre-Flare Configuration of Active Region AR4474. For publication in Solar Physics, Utrecht, The Netherlands.

VIBBART, CHARLES M. EP73
Transient Pressure Test Article Test Program Paper. For presentation at the 11th Aerospace Testing Seminar, Manhattan Beach, California, October 11, 1988.

VONNEGUT, B. University of New York
VAUGHAN, O. H. ED43
Vertical Lightning Discharges into Clear Air Above Thunderstorms. For presentation at the 8th International Conference on Atmospheric Electricity, Uppsala University, Uppsala, Sweden, June 13-16, 1988.

WAITES, HENRY ED12
SELTZER, SHERMAN M.

WAITES, HENRY B. ED12

WAITES, HENRY B. ED12
SINGH, RAMEN
WATIES, HENRY B.  
Marshall Space Flight Center's (MSFC)  
Multibody Modeling and Verification  
Program. For presentation at the SDIO/  
NASA Workshop on Multibody Simulation,  

WALKER, A. B. C., JR.  
HOOVER, R. B.  
et al.  
Soft X-Ray Images of the Solar Corona with  
a Normal-Incidence Cassegrain Multilayer  
Telescope. For presentation at the Optical  
Society of America, North Falmouth, Cape  

WALKER, A. B. C., JR.  
BARBEE, T. W., JR.  
HOOVER, R. B.  
LINDBLOM, J. F.  
Soft X-Ray Images of the Solar Corona with  
a Normal-Incidence Cassegrain Multilayer  
Telescope. For presentation at the American  
Physical Society Topical Conference on  
Plasma Astrophysics, Santa Fe, New  

WALKER, A. B. C., JR.  
HOOVER, RICHARD B.  
et al.  
Soft X-Ray Images of the Solar Corona with  
a Normal Incidence Cassegrain Multilayer  
Telescope. For publication in Science,  
Washington, D.C.

WALLS, BRYAN  
Starr: An Expert System for Failure Diagnos-  
sis in a Space Based Power System. For  
presentation at the IECEC '88, Denver,  

WANG, CAROLINE K.  
PURINTON, STEVE  
Automatic Mathematical Modeling for Real  
Time Simulation System. For presentation at  
the 1988 Goddard Conference on Space  
Applications of A.I., Greenbelt, Maryland.

WANG, C.  
ZEANAH, H.  
ANDERSON, A.  
PATRICK, C.  
Automatic Detection of Electric Power  
Troubles. For presentation at the SOAR 88,  

WANG, CAROLINE K.  
YOSHIMURA, HIROKAZU  
KUNDU, MUKUL, R.  
A Two-Zone Model of Coronal Hole Struc-  
ture in the High Corona. For presentation at  
the 9th Sacramento Peak Summer Workshop,  
Sunspot, New Mexico, August 17-21, 1988.

WANG, ZHENZHI  
YOSHIMURA, HIROKAZU  
KUNDU, MUKUL, R.  
Two-Dimensional Magnetohydrodynamics  
of the Two-Zone Model of Coronal Hole  
Flows. For presentation at the 1988 Spring  
Meeting American Geophysical Union,  
Baltimore, Maryland, May 16-20, 1988.

WANG, ZHENZHI  
HATHAWAY, D. H.  
Meter-Decameter Wave Radio Images and  
Potential Magnetic Fields of the Solar  
Corona. For publication in the Proceedings:  
Study of Traveling Interplanetary  
Phenomena Meeting (STIP), Huntsville,  
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

WEEKS, DAVID J. EB12
WALSH, RICK
FREEMAN, KEN

WEEKS, DAVID J. EB12

WEEKS, DAVID J. EB12
WALSH, RICK

WEEKS, DAVID J. EB12

WEEKS, DAVID J. EB12
LOLLAR, LOUIS F.

WEEKS, DAVID J. EB12

WEST, E. A. ES52
REICHMANN, E. J.
HAGYARD, M. J.
GARY, G. A.
Development of the Polarimeter for the SAMEX Vector Magnetograph. For publication in Optical Engineering, Bellingham, Washington.

WEST, EDWARD A. ES52
REICHMANN, EDWIN J.

WEST, E. A.
HAGYARD, M. J.
GARY, G. A.

WEST, E. A.
HAGYARD, M. J.
GARY, G. A.

WHITLEY, K.
CARRASQUILLO, R.
HOLDER, D.
HUMPHRIES, R.
WILKINSON, LADY E KATHRYN  ES52
EMSLIE, A. GORDON
GARY, G. A.

WILLIAMS, A. C.  ES65

WILLIAMSEN, JOEL E.  ED52
HANSEN, LAWRENCE L.  MMC

WILSON, G. S.  ED41
CURRAN, R. J.
BUTLER, D. M.

WILSON, R. B.  ES62
FISHMAN, G. J.
et al.

WILSON, R. B.  ES62
FISHMAN, G. J.
MEEGAN, C. A.
PACIESAS, W. S.
PENDLETON, G. N.

WILSON, ROBERT M.  ES52

WILSON, ROBERT M.  ES52

WILSON, ROBERT M.  ES52
Reply. For publication in Planetary Space Science, Great Britain.

WILSON, ROBERT M.  ES52

WILSON, ROBERT M.  ES52
Predicting the Maximum Amplitude for the Sunspot Cycle from the Rate of Rise in Sunspot Number. For publication in Solar Physics, Utrecht, Netherlands.

WILSON, ROBERT M.  ES52
A Prediction for the Maximum Phase and Duration of Sunspot Cycle 22. For publication in the Journal of Geophysical Research, Washington, D.C.

WILSON, ROBERT M.  ES52

WINGLEE, R. M.  ES53
WAITE, J. H.
et al.
Particle Acceleration and Wave Emissions Associated with the Formation of Auroral Cavities and Enhancements. For publication in the Journal of Geophysical Research, Washington, D.C.

WOLFSBERGER, JOHN W.  EB42
MCKEE, JIM

WOLFSBERGER, JOHN W.  
DAVIS, STEPHEN  
HAYS, DAN  


WOLFSBERGER, JOHN W.  
SCHROER, BERNARD J.  
TSENG, FAN T.  
ZHANG, S. K.  


WOOD, WALTER V.  
BAUGHER, CHARLES R. II  


WRIGHT, K. H., JR.  
STONE, N. H.  
et al.  


WU, M. K.  
ASHBURN, J. R.  
HIGGINS, C. A.  
FELLOWS, C.  

LOO, B. H.  
BURNS, D. H.  
IBRAHIM, A.  
ROLIN, T.  
PETERS, P. N.  


WU, S. T.  
STEINOLFSON, R. W.  
TANDBERG-HANSSEN, E.  


WU, S. T.  
BAO, J. J.  
AN, C.-H.  
TANDBERG-HANSSEN, E.  

A Numerical Magnetohydrodynamic (MHD) Simulation of Prominence Formation with Condensation and Thermal Conduction. For publication in the Proceedings of Workshop on Dynamics and Structure of Solar Prominences, Palama De Mallorca, Spain.

XIAO, Y. C.  
WU, S. T.  
SUSS, S. T.  
MUSIELAK, Z. E.  
SUESS, S. T.  


XIAO, Y. C.  
WU, S. T.  
MUSIELAK, Z. E.  
SUSS, S. T.  

A Numerical MHD Simulation Model for the Study of Flux Tube Waves. For presentation at the American Astronomical Society Solar
Physics Division Meeting, Kansas City, Missouri, June 5-9, 1988.

XU, JIAN-JUN ES75

XU, JIAN-JUN ES75

XU, JIAN-JUN ES75

XU, JIAN-JUN ES75

XU, JIAN-JUN ES75

YOSHIMURA, H. ES52
HATHAWAY, D.
Dynamo Generation of the Highly Tilted and Offset Dipole Magnetic Field of Uranus. For publication in Geophysical Research Letter, Washington, D.C.

YOSHIMURA, HIROKAZU ES52
WANG, ZHENGZHI
KUNDU, MUKUL R.
A Coronal Hole Two-Zone Model of Density, Temperature and Magnetic Field Between 1.3 and 2.0 Solar Radii. For presentation at the Spring 1988 Meeting American Geophysical Union, Baltimore, Maryland, May 16-20, 1988.

YOSHIMURA, HIROKAZU ES52
Solar Cycle Variations of the Corona and Their Implications for Dynamics of the Interior and the Heliosphere. For presentation at the 9th Sacramento Peak Workshop, Sunspot, New Mexico, August 17-21, 1988.
APPROVAL

FY 1988 SCIENTIFIC AND TECHNICAL REPORTS,
ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by Joyce E. Turner

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

C. D. BEAN
Director, Administrative Operations Office