



SEE

Bulletin



Developing Tomorrow's Space Technologies Today

NASA's Space Environments and Effects Program

Spring 1998 Issue

SEE Program Selects New Technology Development Activities

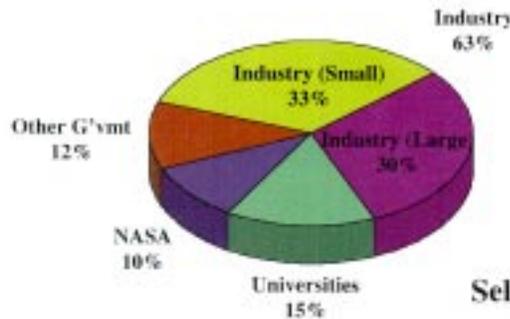
The NASA Research Announcement (NRA) for the SEE Program was released last year and the final results are complete. The SEE Program is proud to announce that twelve new

activities have been selected and awarded. The SEE Program knows that the study of the space environment is generating more interest in the science and engineering community than ever before and the new

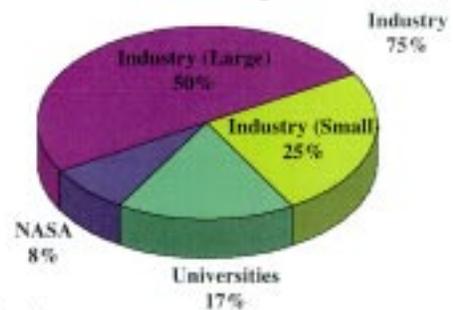
proposals will definitely improve the engineering tools that can be readily implemented to increase our knowledge and understanding of the space environment.

The following charts provide a summary of the proposal and funding distributions:

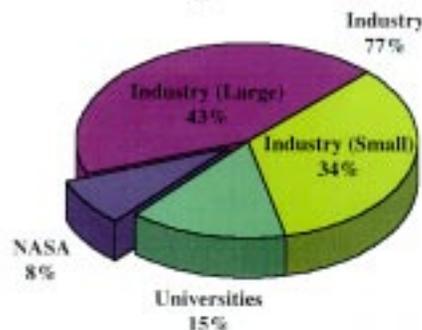
Submitted Proposals



Selected Proposals



Funding Distribution



NOTICE

The SEE Program Office's area code has changed from 205 to 256. Please make a note of this change. The 205 area code will be good until September, 1998.

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Announcing the 6th
Spacecraft Charging
Technology Conference
Nov. 2-6, 1998
Air Force Research Lab,
Hanscom AFB, MA, USA

Sponsored by:

- *Air Force Research Laboratory - Space Vehicles Dir.*
- *NASA Space Environments and Effects Program*
- *NASA Lewis Research Center*
- *ESA/ESTEC, European Space Research and Technology Centre*

Persons interested in attending should visit one of the web sites listed below, prepare a simple text abstract or preliminary registration using the suggested format, and e-mail it to scct98@plh.af.mil before June 2, 1998. Correspondence will be conducted entirely by e-mail. For more information or to be added to the e-mail list, send a message to scct98@plh.af.mil, or contact these individuals or web sites:

- D. Cooke cooke@plh.af.mil
- S.T. Lai lai11@plh.af.mil
- A. Hilgers ahilgers@estec.esa.nl
- M. McCollum matt.mccollum@msfc.nasa.gov
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- <http://www.plh.af.mil>
- <http://see.msfc.nasa.gov/>
- http://www.estec.esa.nl/wmwww/wma/scc_1998

Notice: Hanscom AFB requires prior approval for access by non-US citizens.

On-Orbit Electric Field Monitor

The Georgia Tech Research Institute has delivered to the SEE program office a final report entitled International Space Station Electric Field Measurement Package (EFMP). The EFMP report is a concept study and implementation plan for developing EFMP. This report can be viewed and downloaded in its entirety at: <http://see.msfc.nasa.gov/see/ee/eepub.html>

AIR FORCE SPACE COMMAND – NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) PARTNERSHIP COUNCIL

by Billy Kauffman

The Air Force Chief of Staff and the NASA Administrator, recognizing that expanded cooperation between the Air Force and NASA is in the best interests of both organizations, have committed to a program of proactive coordination of activities in areas of mutual interest. A number of cooperative efforts are already being pursued, such as personnel exchanges, participation in planning processes and source selections, test program management, and joint studies of future concepts and requirements. However, additional efforts between Air Force Space Command and NASA are possible and desirable.

The Partnership Council was established to expand cooperation between Air Force Space Command and NASA. This cooperation is intended to achieve efficiencies, risk reduction, and better understanding of plans and activities in areas of mutual interest. Improving the level of interaction between the organizations should lead to harmonized long-range planning, more efficient resource allocation, expanded technology partnerships, and more compelling advocacy of programs.

There are seven Air Force-NASA Study Teams:

- 1) **Feasibility of DSP Shuttle Launch**
- 2) **Space Shuttle Launch of Air Force Technology Satellite**
- 3) **Integrated Advance Space Transportation Plan**
- 4) **Infrastructure and Common-use Facilities**
- 5) **Space Debris**
- 6) **Clementine II Collaboration**
- 7) **Expanded Cooperation on Space Environment**

The "Expanded Cooperation on the Space Environment" study team is co-chaired by Colonel Gerald Whittman (USAF) and Dr. George Withbroe (NASA Headquarters). Colonel Whittman and Dr. Withbroe divided their study team into four groups:

- 1) **Planning and Roadmaps**
- 2) **Data and Communications**
- 3) **Operational Models**
- 4) **Space Environment Effects**

The Space Environment Effects Working Group (SEEWG) is chaired by Steven D. Pearson, manager of NASA's Space Environments and Effects Program. Consisting of Air Force and NASA personnel, the SEEWG's purpose is to develop an integrated roadmap to identify and coordinate the collaboration efforts of the appropriate technical experts. The SEEWG also will help with the evaluation how the U.S. Air Force and NASA arrives at the definition of the space environments and their effects on spacecraft and spacecraft systems. The technical disciplines covered by the SEEWG are: Ionosphere and Thermosphere effects, Solar activity and effects, Plasma/Spacecraft Charging effects, Contamination effects, and Ionizing Radiation effects.

On March 17th, 1998, at Hanscom Air Force Base, Mr. Kauffman, of the SEE Program Office, presented the results of the first round of meetings of the SEEWG to Colonel Whittman and Dr. Withbroe. Along with Dr. Dana Brewer, NASA Headquarters and SEE Program sponsor, Mr. Kauffman also presented a

Optical Properties Monitor (OPM)

by Don Wilkes, AZ Technology

The Optical Properties Monitor (OPM) is a multifunctional, reusable in-flight laboratory for the in-situ study of materials. The first mission for OPM was on the Russian space station Mir. Selected materials were exposed to the low earth orbit space and Mir induced environment and their effects measured through in-situ measurements and post-flight analyses.

Optical and thermal properties were measured by OPM in-situ measurement subsystems: spectral total hemispherical reflectance, Total Integrated Scatter (TIS), Vacuum UltraViolet (VUV) reflectance/transmittance, and total emittance. Environmental monitors measured selected components of the test sample exposure environment (solar/earth irradiance, molecular contamination, and atomic oxygen).

Detailed optical and thermal properties, surface degradation, and contamination will be determined by post-flight analyses.

The overall OPM experiment objective was to study the effects of the Mir space environment, both natural and induced, on optical, thermal control, solar array, and other materials.

The OPM was carried to Mir in a SpaceHab double rack on STS-81 in January, 1997. It was deployed on the exterior of the Mir Docking Module (DM) by a joint US/Russian EVA and powered up at 02:21 CDT (07:21 GMT) on April 29, 1997. OPM operated until January 8, 1998. The power was off from June 25, 1997 to approximately September 9, 1997 due to the Progress accident. There were a number of other power outages in the days following power restoration. When power was on to OPM there were weekly optical properties

measurements and continuous environmental monitoring. The data was downlinked through the MIPS system. OPM was retrieved from the Docking Module on January 9, 1998 (MT) by Russian EVA and returned to ground on STS-89 later that month.

In-flight data has been reduced and processed. Summaries of OPM data were presented to the ISS materials and contamination community in a January 13, 1998, ISS Technical Interchange Meeting (TIM). Post-flight activities have included de-integration from SpaceHab, functional testing, visual inspection, and return of OPM to the laboratory for continued analysis.

Most OPM instruments and subsystems performed very well over the Mir mission providing unique data on the behavior of materials in the Mir

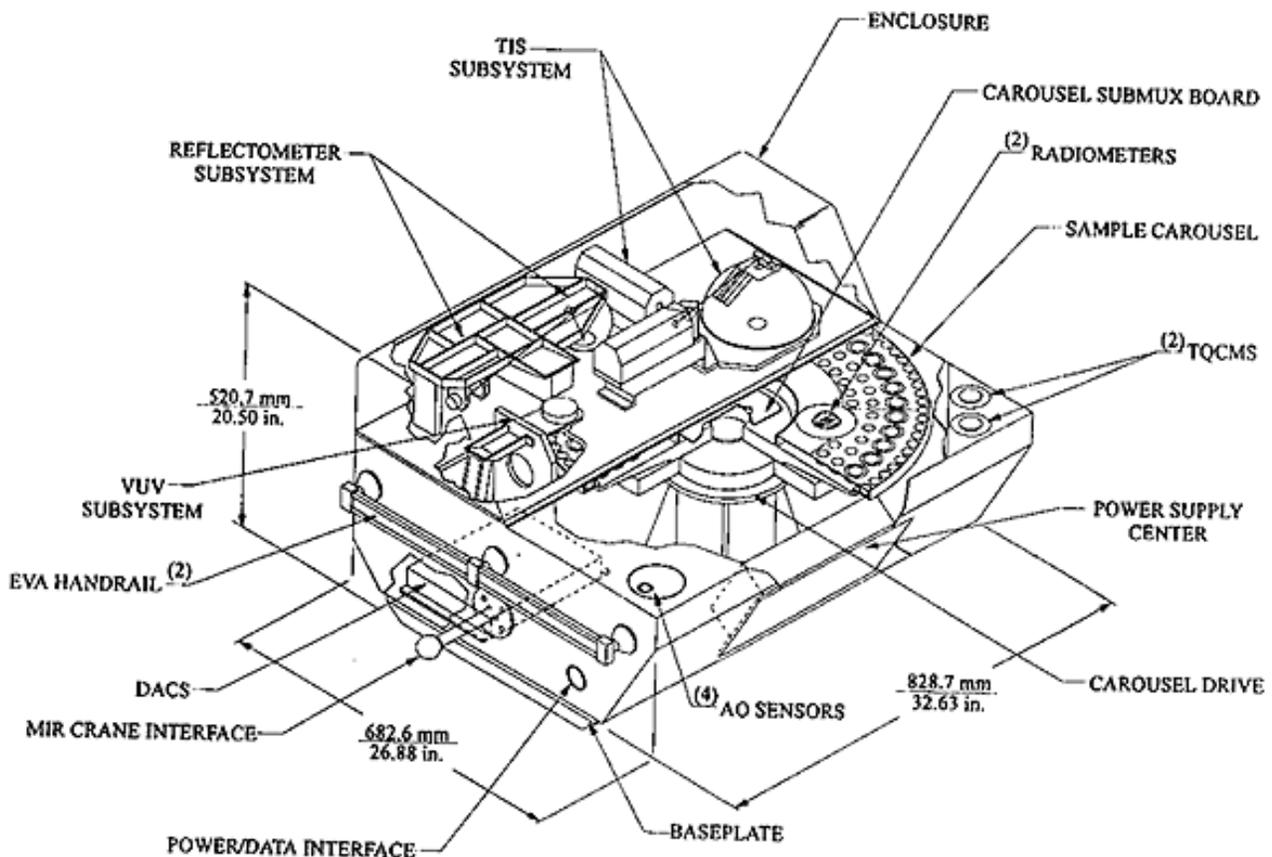


Figure 1. OPM Assembly

Optical Properties Monitor (OPM)

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Table 1. Basic OPM Specifications.

Size (LxWxH) includes MLI	82.9 x 68.3 x 52.1 cm (32.6" x 26.9" x 20.5")
Weight OPM w/MLI, EVA handrails, sample cover & flight bag Deployed weight with Interface Plate and Latch	117.3 kg (258 lbs) 146.8 kg (323 lbs)
Power Source Average Peak	Spacecraft 27 VDC 56 Watts (+39 Watts for Heaters) 196 Watts
Spacecraft Command/Data I/F Type Data Rate	RS-422 300 kbytes/week
Thermal Control System	Passive - Ext. Radiator w/Heaters
Test Sample Capacity	72 Active Samples 26 Passive Samples

environment. There were three anomalies identified for the OPM/Mir mission

- VUV spectrometer lamp did not function during the mission.
- The solar radiometer ceased to operate during the full sun Mir orbit in early June.
- The reflectometer tungsten lamp failed during the final in-space measurement cycle.

Preliminary results show less than 200Å of molecular contamination were measured by the TQCMs. The OPM samples (and TQCM) field-of-view was of 6-11 year old modules. No significant optical contamination effects were measured by the OPM reflectometer (250-2500 nm). The sides of OPM show significant degradation with distinct shadowing from OPM handrails. Some flight samples were very stable for the OPM mission. The OPM reflectometer measured significant exposure effects on some flight samples. Some post-flight recovery (bleaching) of environment effects have been measured on several samples verifying the need for in-space optical measurements.

In conclusion, the OPM performed well on the mission to Mir and demonstrated its capability to measure the in-space behavior of materials and monitor

selected components of the exposure environment. The processed in-flight OPM data has already provided the ISS community with unique and valuable data on the performance of materials in the Mir space environment. Subsequent analysis of test materials and OPM external surfaces will provide additional insight into material environmental effects around a space station.

The ISS materials and contamination community at the January ISS TIM has

recommended that the OPM be refurbished and reflown on ISS along with other materials experiments as soon as possible to provide this unique capability for early ISS activities.

For more information, please see the Internet web sites at <http://www.azhsv.com> and <http://see.msfc.nasa.gov/see/see.html>.

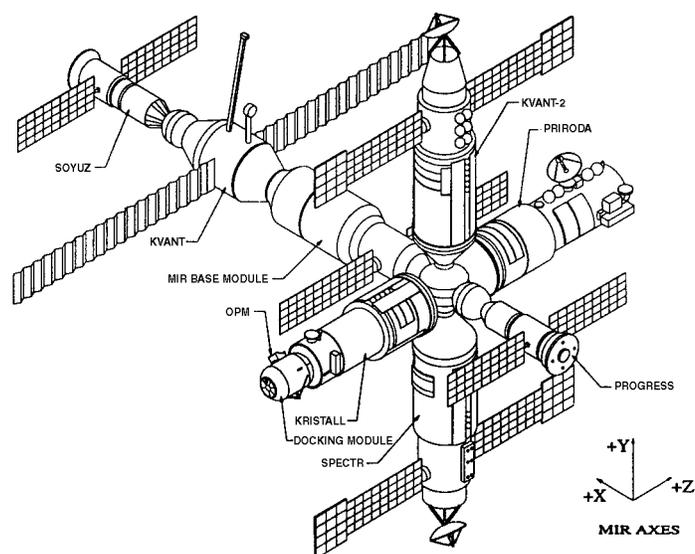


Figure 2. OPM Mir Mounting on Docking Module

AIR FORCE SPACE COMMAND – NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) PARTNERSHIP COUNCIL

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recommendation to the Partnership Council on how to continue and develop the identified opportunities by the technical experts from both agencies. The recommendation was well received and will officially bring USAF/AFRL participation to the SEE Program and SEE Program Office. After all formal paperwork is completed and signed (Memorandum of Agreement (MOA), charter and an implementation plan), the SEE Program will become a co-advocated and resource program across both agencies. The program will jointly establish visionary planning, environment requirements, data policies and flight demonstrations required for future technology development opportunities. This will allow leveraging of present and future technology demonstrations to reduce possible duplication of efforts.

For a final copy of the technical report and matrices on recommendations, please email Billy Kauffman at: billy.kauffman@msfc.nasa.gov.

The Space Environments and Effects Program (SEE) announces the 1998 SEE Flight Experiments Workshop

**June 23-25
Four Points Hotel
Huntsville, AL**

Objective:

The objective of the workshop is to provide a forum for the exchange of information regarding the effects of the space environment on exposed spacecraft surfaces and on flight experiments designed to measure the space environment and its effects. Results from a number of flight experiments will be presented and the implications of these observations on future missions will be discussed. The workshop will emphasize the problems which need to be resolved in order for future spacecraft to survive space environments in light of changing technologies, priorities, and budgetary constraints. An understanding of the flight experiments or technical development activities which need to be planned by the SEE program in future roadmap efforts will also be generated. An agenda of the meeting will be distributed within the next few weeks.

Registration Information:

The 1998 SEE Flight Experiments Workshop will convene June 23-25, 1998, in the Four Points Hotel located at the Huntsville International Airport in Huntsville, Alabama. Registration will take place on Tuesday, June 23, 1998, beginning at 7:30 a.m. The registration fee for this workshop is \$50.00. The registration fee includes administrative costs and breaks during the meeting.

The registration form is available via the World Wide Web at:

<http://space.hsv.usra.edu>

Please fill out the registration form and send all remittances to:

Debra G. Hallmark, Office Administrator
Universities Space Research Association (USRA)
4950 Corporate Drive, Suite 100

SEE Program Awards New Technology Development Activities

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The selected proposals cover six space environment technical disciplines: electromagnetic effects; ionizing radiation; meteoroid & orbital debris; materials and processes; neutral external contamination; plasma/spacecraft charging.

For a listing of the proposal titles, organizations, principal investigators and objectives, please visit the SEE Program's website at: <http://see.msfc.nasa.gov/see/whatsnew.html>.

Technology Experiment Facility

by Stu Clifton

A survey in the form of a questionnaire was released to the Space Environments and Effects (SEE) and other technology development communities to solicit requirements for potential experiments which could be flown aboard the Technology Experiment Facility (TEF) planned for the International Space Station (ISS) in early 2004. TEF is an ISS-truss attached payload facility accommodating a minimum of 26 exposure trays of approximately 1m x 1m footprint and less than 1.25 m height. The TEF will provide structural as well as standard ISS data and power services for material and electronic component exposure and space environment payloads. The capability for data management services includes data formatting, data multiplexing, and command distribution to payloads. TEF will also support on-orbit installation, removal, and change-out of payloads, using ISS standard logistics and Extra Vehicular Robotics (EVR) capability in addition to planned and/or contingency crew extra-vehicular activities. The TEF provides zenith or nadir, RAM, wake, starboard, and port exposure capability. A goal of the TEF is to provide as much commonality with EXPRESS Pallet as possible to simplify interface design. While draft specifications for the TEF have been developed, results from the survey will be used to determine the user requirements that will be incorporated into future design specifications.

Coming in Summer 1998 Issue...

- *OTTI Workshop Results*
- *Flight Experiment Workshop Results*

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and
Homepage Site**

We are sending this issue to people we believe will be interested in the SEE Program. If you are not, please pass it on to someone else and let us know. Anyone interested in receiving the SEE Bulletin, may contact Ms. Belinda Hardin at:

E-Mail: belinda.hardin@msfc.nasa.gov
Fax: (256) 544-8807

Previous issues and current information can be found by visiting our homepage at:
<http://see.msfc.nasa.gov/>

Recent Website Additions:

- **SBIR Announcements**
<http://see.msfc.nasa.gov/see/whatsnew.html>
- **6th Annual Spacecraft Charging Technology Conference**
http://see3.msfc.nasa.gov/sec_1998x.html
- **List of 1997 SEE Proposals Awarded**
<http://see.msfc.nasa.gov/>
- **Returned Russian Solar Array**
<ftp://ftp-msd.ksc.nasa.gov/msd/Russian%20Solar%20Array>
- **Test Report - Fault Current Through Graphite Filament Reinforced Plastic, NASA CR-4774**

Test Report - Direct and Indirect Lightning Effects on Composite Materials, NASA CR-4783

Design Guidelines for Shielding Effectiveness, Current Carrying Capability, and the Enhancement of Conductivity of Composite Materials, NASA CR-4784

System Guidelines for EMC Safety--Critical Circuits: Design, Selection, and Margin Demonstration, NASA CR-4759

On-Orbit Electric Field Monitor Report

<http://see.msfc.nasa.gov/see/ee/eepub.html>
- **Meteoroids and Orbital Debris: Effects on Spacecraft, NASA RP-1408**
<http://see.msfc.nasa.gov/see/mod/modpub.html>

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