SEE Bulletin
Developing Tomorrow's Space Technologies Today
NASA's Space Environments and Effects Program
Spring 1999 Issue

NASA (Code SM) Changes Prompt Restructuring of SEE Program NRA Process

By Jody Minor

The Advanced Technology & Mission Studies (AT&MS) Division, Code SM of NASA Headquarters, has initiated a new program structure to better serve the NASA Enterprises. This new program, called the Cross-Enterprise Technology Development Program (CETDP), affects all cross-cutting technology development activities within NASA, including the SEE Program. The new program structure establishes new 'thrust areas' which focus technology development activities into specific areas. The SEE Program is part of the "*Ultra-Light Structures and Space Observatories*" Thrust Area. This particular thrust area combines space environments and effects with such disciplines as materials and optics.

With this new program comes a new way of doing business. In the past, the SEE Program has directly issued SEE related NASA Research Announcement (NRA) solicitations to support our technology development activities. Now, our NRA solicitations will be part of a bigger, more general solicitation by the CETDP, issued at least once every year starting in 1999. This means that more areas are competing for the technology funding. The NRA solicitations will contain only those areas that the customers (i.e. Space Science Enterprise, Earth Science Enterprise, Human Exploration and Development of Space Enterprise and Office of the Chief Technologist) feel are important and relevant to their work. The SEE Program will make sure that those areas important to the NASA Enterprises are represented in the NRA solicitations; however, unlike before, the final selections will be made by NASA Headquarters.

Contracts that are currently being funded by the SEE Program under NASA NRA 8-20 will continue to operate under the original terms of the contracts until completion. The new program will not affect any contract currently being funded.

The SEE Program had originally planned to issue a new space environments and effects NRA solicitation in the year 2000. However, because of the new program restructuring, those plans were put on hold due to participation in the first CETDP NRA solicitation in early 1999. This solicitation is not open to NASA field centers. A second CETDP NRA solicitation is planned for fall 1999, which will be open to all US government and industry organizations. Details of where to find the NRA information will be on the SEE website at **http://see.msfc.nasa.gov/** and distributed via the *SEE Bulletin* mailing list once the NRA has been issued.

Also, the SEE Program is currently trying to determine if we will be able to continue to issue independent SEE NRA soliciations in addition to the general CETDP NRA currently in work. An independent NRA would allow the SEE Program to seek funding for SEE technology development activities that were not funded through the CETDP NRA. An answer to this question should be determined before the next fiscal year begins in October 1999.

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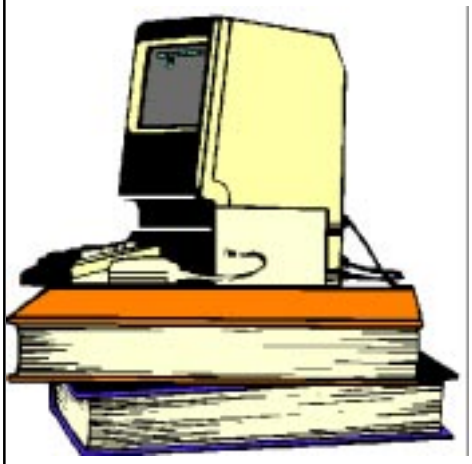
Teacher's Resource Toolkit

During the summer of 1998, Jason Parks worked in the Electromagnetics and Aerospace Environments Branch of the Marshall Space Flight Center via a contract with Universities Scientific Research Associates. Jason was on summer break from his studies at Sparkman High School in the Madison County School System.

Working with members of the Electromagnetic Environmental Effects (E3) team, Jason developed a teachers resource toolkit for lessons in electromagnetism. Concepts introduced by the toolkit include electrical conductors and insulators, Ohm's Law, properties of magnets, both natural and man-made electromagnetic interference, and shielding. The toolkit will soon be available on the SEE website (http://see.msfc.nasa.gov) for use by educators, parents, students, or anyone else interested in electricity and magnetism.



Space Vehicle Glow Models

by Miria Finckenor

A visible red glow has been observed on ram surfaces on the Space Shuttle, as well as other spacecraft, including the Atmospheric Explorer and the Dynamic Explorer-B. The glow is caused by interaction between the atomic oxygen in low Earth orbit and nitrogen oxide (NO) trapped on the spacecraft surface which produces NO_2. Water vapor outgassed from the spacecraft also interacts with the atmosphere to produce glows in the infrared region. These glows may interfere with astronomy experiments unless steps are taken to mitigate or eliminate them.

The intensity and spectral shape of the glow is dependent on altitude, spacecraft material, and spacecraft temperature. The lower the orbital altitude, the higher the concentration of atomic oxygen to react with the spacecraft. Irregular surfaces such as shuttle tiles offer a large surface area for NO to stick. Colder temperatures keep more NO on the surface. NO is found naturally in the upper atmosphere and also in thruster effluent. When effluent is directed upstream to re-encounter surfaces, orbiter surfaces become doped by the orbiter flying through the effluent.

Dr. Gary Swenson of the University of Illinois at Urbana has developed three models to predict vehicle-atmosphere interaction glows. The visible model plots intensity vs. wavelength for 4000 to 8000 Angstroms for ram angle, altitude, and surface temperature effects. The ultraviolet wavelength model characterizes the beta, gamma, and delta emission bands for NO for wavelengths of 2000 to 3000 Angstroms. The infrared wavelength model calculates the emission spectra of outgassed water vapor excited by collision with atomic oxygen and oxygen ions for wavelengths of 1 to 10 μm.

These models are written in FORTRAN with output code in IDL and will be available through the SEE Program website in the near future. Dr. Swenson also has guidelines for future spacecraft designers to mitigate glow and will also be available through SEE website in the very near future. The website address is http://see.msfc.nasa.gov. The guidelines are summarized here:

1) Orbiting at higher altitudes reduces glow linearly with the decreasing in O. The atmospheric O density decreases by a factor of e (2.73) every 50 km, thus 50 km higher altitude will reduce the glow brightness by e. In addition, the atmospheric source of NO is reduced.
2) The release of inert or non-reactive gases into the up stream (into the velocity vector) can interact with the ramming atmospheric O before it reaches orbiter surfaces. This was demonstrated on STS62, with an N_2 release. This would not be practical as a general, long term solution, but it certainly is very effective for short periods.
3) Attitude control should be maintained by gyros rather than thrusters where optical instruments are the primary payload. If thrusters using monomethyl hydrazine are to be used for attitude control, they should be directed so they do not impinge material back onto spacecraft surfaces. The effluent in the burn will then escape quickly, and only the bright gas phase emission will be visible for a brief time.
4) Non-hygroscopic surfaces are better since, at a given temperature, less real surface area per subtended area is available to hold surface sticking molecules, such as NO. Non-hygroscopic materials also absorb less water vapor to produce glow in the infrared wavelengths.

Space Vehicle Glow Models

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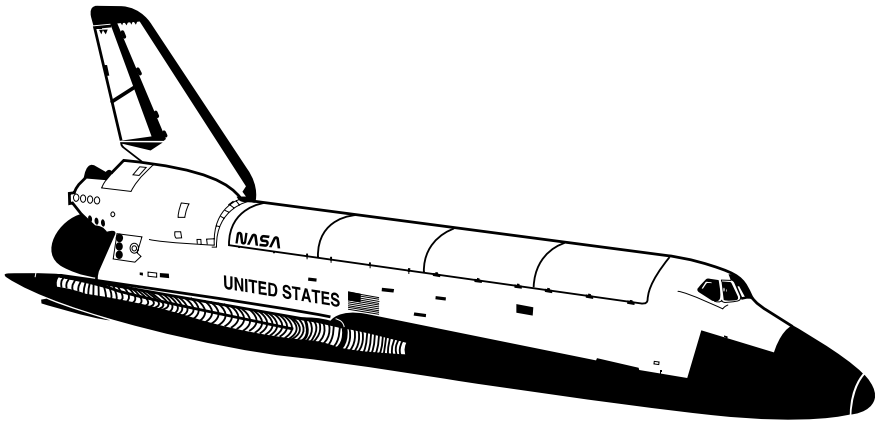
5) Warmer temperatures of surfaces results in lesser NO molecules being bound to the surfaces, and thus not available for heterogeneous processes. This is likely a very practical solution for elimination of baffle glows for instance, where changing the material is not practical. The temperature relationship for a given material follows closely with I=IoEXP(E/kT), where E=0.14 eV, k is Boltzman's constant, and T in Kelvin.



Pulse Height Analyzer (PHA) Performs Flawlessly During STS-95 Mission

by E.G. Stassinopoulos

The first space flight of the newly developed "High-LET Radiation Spectrometer" (HILRS), also known as "Pulse Height Analyzer" (PHA), was a resounding success.

The space certified instrument, designed on microelectronic principles by the Radiation Physics Office of the Electrical Systems Center of Applied Engineering Technology Directorate, was flown on the 9-day STS-95 mission. It was part of the HST Orbital Systems Test (HOST) cradle on the Shuttle Discovery.

The primary objective of the detector was to measure the energy deposited: (a) by galactic and solar cosmic rays and their progeny from interactions with the spacecraft materials, and (b) by spallation / fractionation / recoil products from energetic trapped protons in the South Atlantic Anomaly (SAA).

The PHA performed flawlessly throughout the entire mission. The measurements of trapped proton events were extremely close to the predicted levels, estimated for the low inclination orbit of Discovery on the basis of instrument calibration and environment prediction.

The principal investigator, E. G. Stassinopoulos, and co-investigator, Craig Stauffer, spent nine intense days alternating on 14-hour shifts in the Payload Operations Control Center at Kennedy Space Center to continuously monitor the performance of the detector.

A similar instrument is scheduled to be launched later this year into a highly eccentric GTO trajectory.

Electromagnetic Effects (EME) Technical Working Group (TWG) Roadmap Meeting

The SEE Program's EME TWG will host a roadmap meeting this summer at the Marshall Space Flight Center. The information obtained will enable the EME working group to update its technical roadmap tasks list and plan for the future. Details will soon be posted on the SEE Website.

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The SEE Program has also renewed its effort to determine the SEE technology needs of the NASA Enterprises. Current technology roadmaps are being updated; new contacts and relationships are being established; and new program plans to better serve our customers are being developed. Of course, the SEE Program will continue to work with other government agencies, industry, and academia to produce needed SEE technology products.

The CETDP is a bold new way to focus the cross-cutting technology development activities within NASA. This means a lot of change in the way we do business. The SEE Program is dedicated to producing quality technology products for the NASA Enterprises and will continue to work hard within the CETDP to make sure this goal is accomplished.

Questions concerning the CETDP and how the SEE Program operates within the program may be directed to Mr. Jody Minor at jody.minor@msfc.nasa.gov or telephone at 256-544-4041.

Coming in Summer 1999 Issue...

- ***Thermospheric Density Predictor Improvements***
- ***MSFC's Engineering Technology Development Office (ETDO) vs. NASA's SEE Program***

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Fax: (256) 544-8807

Previous issues and current information can be found by visiting our homepage at:

http://see.msfc.nasa.gov/

Miscellaneous

Don't miss the SEE Display at the Nuclear Space Radiation Effects Conference (NSREC) in Norfolk, VA. The SEE Program will debut two new IR models and a sample of data from an effort of global mapping of atmospheric cosmic ray progeny.

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