



NASA STTR 2007 Phase I Solicitation

T1 Information Technologies for System Health Management And The Study of Space Radiation Environments and Associated Health Risks

This topic seeks advances in the design, development, and operation of complex aerospace systems to enable safe operation in the event of system failures, innovative technologies for radiation detection and measurement, and emerging technologies that will enable the determination and management of the health of advanced aircraft and space exploration crews and vehicles.

Subtopics

T1.01 Information Technologies for System Health Management, Autonomy, and Scientific Exploration

Lead Center: ARC

Information technology is a key element in the successful achievement of NASA's strategic goals. Modern tools and techniques have the capability to redefine many design and operational processes as well as enable grand exploration and science investigations. This subtopic seeks innovative solutions to the following information technology challenges:

- Onboard methods that monitor system health and then automatically reconfigure to respond to failures and sustain progress toward high-level goals. Special emphasis will be on computational techniques that enable lifecycle consistency in system characterization during design through operations with engineering and data models. Proposals should focus on data analysis and interpretation rather than development of new sensors.
- Onboard, real-time health management systems that perform quickly enough to monitor a flight control system (including spacecraft and fixed or rotary wing aircraft) in a highly dynamic environment and respond to anomalies with suggested recovery or mitigation actions.
- Data fusion, data mining, and automated reasoning technologies that can improve risk assessments, increase identification of system degradation, and enhance scientific understanding.

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- Techniques for analyzing and reasoning from development and operational data sets to identify degradation of components and predict remaining useful life.
 - Techniques for interconnecting and understanding large heterogeneous or multidimensional data sets or data with complex spatial and/or temporal dynamics.
 - Computational and human/computer interface methodologies for inferring causation from associations and background knowledge for scientific, engineering, control, and performance analyses.

T1.02 Space Radiation Dosimetry and Countermeasures

Lead Center: ARC

As NASA embarks on its exploration agenda, the study of space radiation environments and associated health risks to astronauts will continue to guide radiation detection technology development and mitigation strategies. The development of suitable radiation detection technologies (both physical and biological) is vital to the success of long-term manned spaceflight. As NASA returns to the Moon and then on to Mars, a series of small, unmanned missions are anticipated followed by manned missions, including long-term (6 months) stays on the surface of the Moon. It is anticipated that the unmanned missions (e.g., small satellites that may even land on the Moon) will provide test beds for new and emerging miniaturized technologies that can be further evaluated on manned missions including on the lunar base. Prior to testing in space, the technologies must be tested using simulated space radiations available at the National Space Radiation Laboratory (NSRL), a NASA funded facility at the Brookhaven National Laboratory in New York. The NSRL is capable of generating high-energy particle radiation from protons to ^{56}Fe nuclei. NASA also supports a facility at Loma Linda University Medical Center capable of generating energetic protons. These facilities enable research studies and technology development in support of NASA funded research. NASA is seeking innovative technologies in the areas described below.

Radiation Measurement Technologies for Small Spacecraft

NASA Ames is interested in flying small spacecraft payloads that measure radiation levels alone as well as in combination with biological payloads. In support of this objective, NASA Ames is seeking:

- Small radiation detectors that measure total dose equivalent;
- Miniaturized, radiation-hardened electronics;
- Technologies for combined radiation and biology payloads.

These technologies must minimize the use of power, volume, and mass, and provide what is needed to interface to a spacecraft bus. In the case of biological payloads, a pressurized environment, and environmental control

including consideration of gas, thermal control, and humidity needed to support the biology experiment, must be provided. Biological experiments ranging from cells to small organisms are of interest.

Radiation Health Monitoring Techniques

Technologies are needed to monitor the adverse effects of spaceflight radiation on human health. The following are of interest:

- Methods that are minimally invasive to the crew and provide monitoring of the biological effects of radiation;
- Application of high throughput analyses and genomic, proteomic, and metabolomic approaches used for other biological problems to space radiation effects;
- Concept and technology development of miniaturized spaceflight devices from existing laboratory-based devices to support the analyses described above.