NASA SBIR 2014 Phase I Solicitation

H11 Radiation Protection

The SBIR Topic area of Radiation Protection focuses on the development and testing of mitigation concepts to protect astronaut crews and exploration vehicles from the harmful effects of space radiation, both in low Earth orbit (LEO) and while conducting long duration missions beyond LEO. All space radiation environments in which humans may travel in the foreseeable future are considered, including geosynchronous orbit, Moon, Mars, and the Asteroids. Advances are needed in mitigation schema for the next generation of exploration vehicles inclusive of radiation shielding systems and structures technologies to protect humans from the hazards of space radiation during NASA missions. As NASA continues to form plans for long duration exploration, it has also become clear that the ability to mitigate the risks posed to both crews and vehicle systems by the space weather environment is also of central importance. Advances in radiation shielding systems technologies are needed to protect humans from all threats of space radiation. All particulate radiations are considered, including electrons, protons, neutrons, alpha particles, light ions, and heavy ions. This topic is particularly interested in mid-TRL (technology readiness level) technologies. Lightweight radiation shielding materials are needed to shield humans in aerospace transportation vehicles, large space structures, space stations, orbiters, landers, rovers, habitats, and spacesuits. The materials emphasis should be on non-parasitic radiation shielding materials, or multifunctional materials, where two of the functions are structural and radiation shielding. Non-materials solutions, such as utilizing food, water, and waste already on board as radiation shielding are also sought. A challenge of particular interest is to contain and use human waste as radiation shielding. Advanced computer codes are needed to model and predict the transport of radiation through materials and subsystems, as well as to predict the effects of radiation on the physiological performance, health, and well-being of humans in space radiation environments. Laboratory and spaceflight data are needed to validate the accuracy of radiation transport codes, as well as to validate the effectiveness of multifunctional radiation shielding materials and subsystems. Also of interest are comprehensive radiation shielding databases and design tools to enable designers to incorporate and optimize radiation shielding into space systems during the initial design phases. Research under this topic should be conducted to demonstrate technical feasibility during Phase I and show a path forward to Phase II hardware demonstration and, when possible, deliver a full-scale demonstration unit for functional and environmental testing at the completion of the Phase II contract.

Reference: Wilson, John W.; Townsend, Lawrence W.; Schimmerling, Walter; Khandelwal, Govind S.; Khan, Ferdous; Nealy, John E.; Cucinotta, Francis A.; Simonsen, Lisa C.; Shinn, Judy L.; and Norbury, John W.: Transport Methods and Interactions for Space Radiations. NASA Reference Publication (RP) 1257, December 1991.

Subtopics

H11.01 Radiation Shielding Systems

Lead Center: LaRC

Participating Center(s): MSFC

Advances in radiation shielding systems technologies are needed to protect humans from the hazards of space radiation during NASA missions. All space radiation environments in which humans may travel in the foreseeable future are considered, including low Earth orbit (LEO), geosynchronous orbit, Moon, Mars, and the Asteroids. All particulate radiations are considered, including electrons, protons, neutrons, alpha particles, and light to heavy ions up to iron. Mid-TRL (3 to 5) technologies of specific interest include, but are not limited to, the following:

- Innovative lightweight radiation shielding materials are needed to shield humans in aerospace transportation vehicles, large space structures such as space stations, orbiters, landers, rovers, habitats, and spacesuits. The materials emphasis should be on non-parasitic radiation shielding materials, or multifunctional materials, where two of the functions are structural and radiation shielding. Phase I deliverables are materials coupons. Phase II deliverables are materials panels or standard materials test specimens, along with relevant materials test data.
- Non-materials solutions, such as utilizing food, water, and waste already on board as radiation shielding. A challenge of particular interest is to contain and use human waste as radiation shielding. Phase I deliverables are detailed conceptual designs. Phase II deliverables are working prototypes.
- Advanced computer codes are needed to model and predict the transport of radiation through materials and subsystems. Advanced computer codes are needed to model and predict the effects of radiation on the physiological performance, health, and well-being of humans in space radiation environments. Comprehensive radiation shielding design tools are needed to enable designers to incorporate and optimize radiation shielding into space systems during the initial design phases. Phase I deliverables are alpha-tested computer codes. Phase II deliverables are beta-tested computer codes.
- Laboratory and spaceflight data are needed to validate the accuracy of radiation transport codes. Laboratory and spaceflight data are needed to validate the effectiveness of multifunctional radiation shielding materials and subsystems. Comprehensive radiation shielding databases are needed to enable designers to incorporate and optimize radiation shielding into space systems during the initial design phases. Phase I deliverables are draft data compilations or databases. Phase II deliverables are formal, publishable, and archival data compilations or databases.