NASA SBIR 2015 Phase I Solicitation

H11 Radiation Protection

Lead Center: LaRC

The SBIR Topic area of Radiation Protection focuses on the development and testing of mitigation concepts to protect astronaut crews 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 (GEO), Moon, Mars, and the Asteroids. Advances are needed in mitigation schema for the next generation of exploration vehicles 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 become clear that the ability to mitigate the risks posed to crews by the space radiation environment is 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, trash, and treated waste already on board as radiation shielding are also sought. 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. When possible, deliver a demonstration unit for functional and radiation testing at the completion of the Phase II contract.Â

Subtopics

H11.01 Radiation Shielding Technologies

Lead Center: LaRC

Participating Center(s): MSFC

Advances in radiation shielding 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 (GEO), Moon, Mars, and the Asteroids. All particulate radiations are considered, including electrons, protons, neutrons, alpha particles, and light to heavy ions. Mid-TRL (3 to 5) technologies of specific interest include, but are not limited to, the following:Â

- Lightweight innovative 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. Materials of interest include, but are not limited to, polymers, polymer matrix composites, nanomaterials, and regolith derived materials. The objective is to replace primary, secondary, and interior structures, including equipment and components, with radiation protective materials. There is particular interest in the development of high hydrogen content materials and materials systems to replace traditional materials (particularly metals). Note that the goal is not necessarily mass reduction. The goal is replacing mass with mass that not only meets structural requirements, but also is more effective for radiation protection. Decreased mass is a bonus. High hydrogen materials can include polymer matrix composites, where the polymer and/or fibers are high in hydrogen content. Phase I deliverables are materials coupons. Phase II deliverables are materials panels or standard materials test specimens, along with relevant materials test data.
- Processing of regolith derived materials for radiation shielding structures is also of interest. The regolith can be combined with polymer matrix materials to increase the hydrogen content. 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 are also of interest. Examples are utilizing food, water, supplies, trash, and treated waste already onboard as radiation shielding. This involves developing and utilizing storage containers for food, supplies, and treated waste as multipurpose radiation shielding. This includes developing multipurpose containers for biomaterials to contain treated waste safely without adversely affecting crew (smell/leakage/handling/transfer). Other options include developing water walls for crew quarters and vehicle walls to be used for storing drinking water, potable water, and treated waste, as well as repurposing the trash and treated waste into protective shielding. Phase I deliverables are detailed conceptual designs. Phase II deliverables are initial prototypes.
- NASA is also interested in out-of-the-box credible solutions for radiation shielding. Phase I deliverables are detailed conceptual designs. Phase II deliverables are initial prototypes.
- Advanced computer codes for rapid computing that can handle complex geometries and large collections of data are needed to model and predict the transport of radiation through space vehicles and structures. These are needed to support optimization studies and analyses for vehicle design and mission planning. Phase I deliverables are alpha tested computer codes. Phase II deliverables are beta tested computer codes.
- Experimental laboratory and spaceflight data are needed to validate the accuracy of radiation transport codes and analysis tools. Phase I deliverables are draft data compilations or databases. Phase II deliverables are formal, publishable, and archival data compilations or databases.

For additional information, please see the following link:Â

- (http://www.nasa.gov/pdf/500436main_TA06-ID_rev6a_NRC_wTASR.pdf)