NASA SBIR 2021 Phase I Solicitation

H12.01 Radioprotectors and Mitigators of Space Radiation-Induced Health Risks

Lead Center: JSC

Scope Title:

Radioprotectors and Mitigators of Space Radiation-Induced Health Risks

Scope Description:

Space radiation is a significant obstacle when sending humans on long-duration missions beyond low Earth orbit. Although various forms for radiation exist in space, astronauts during Lunar or Mars missions will be exposed constantly to galactic cosmic radiation (GCR), which consists of high-energy particles ranging from protons to extremely heavy ions. Astronaut health risks from space radiation exposure are categorized into cancer, late and early central nervous systems (CNS) effects, and degenerative risks, which include cardiovascular diseases (CVD) and premature aging. With the current gender and age-specific exposure limits for cancer risks, few female astronauts will be able to fly long-duration missions without countermeasures.

This subtopic solicits proposals to develop biological countermeasures that mitigate one or several of the radiation risks associated with space travel. Compounds that target common pathways (e.g., inflammation) across aging, cancer, cardiovascular disease, and neurodegeneration would be preferred. Most of the countermeasure developments in the medical arena have focused on mitigating the effects of X- or gamma rays. The proposed project should focus on repurposing of technology and compounds for high-energy charged-particle applications. Compounds that are under current development or have been proven effective for other applications are both suitable for this subtopic.

Expected TRL or TRL Range at completion of the Project:Â 5 to 8Â
Primary Technology Taxonomy:Â
Level 1: TX 06 Human Health, Life Support, and Habitation SystemsÂ
Level 2: TX 06.5 Radiation**Â**
Desired Deliverables of Phase I and Phase II:

- Analysis

Desired Deliverables Description:

Deliverables for Phase I of the project will be data generated in testing the proposed radioprotectors with high energy protons. The company should test the proposed radioprotectors using high energy protons or other charged particles at space relevant

doses. This testing can be performed with cell models at an accelerator facility of choice. After contract award, the company should immediately coordinate with the NASA technical monitor for any special considerations for the testing.

In Phase II of the project, the company should conduct in vivo evaluation of the radioprotectors using appropriate animal models, which may include humanized mouse models. Testing in Phase II of the project should be performed with a combination of different particle types and energies that simulate the space radiation environment. NASA will make the accelerator facility at the Brookhaven National Laboratory available for both Phase I and II of the project. Demonstration of the effectiveness in reducing proton-induced biological impacts is needed for a successful Phase II proposal. Deliverables for Phase II of the project will be data generated using animal models and a combination of charged particle types and energies.

State of the Art and Critical Gaps:

Exposure of crew members to space radiation during Lunar and Mars missions can potentially impact the success of the missions and cause long-term diseases. Space radiation risks include cancer, late and early CNSÂ effects, CVD, and accelerated aging. Abiding by the current exposure limits for cancer risks, few female astronauts will be able to fly long-duration missions. Mitigation of space radiation risks can be achieved with physical (shielding) and biomedical means. This subtopic addresses development of drugs that mitigate one or several of the identified space radiation risks. Development of countermeasures for adverse health effects from radiation exposure is also actively supported by the Department of Defense (DOD), Department of Homeland Security (DHS), and the National Institute of Health (NIH). However, some of the radioprotectors used in radiotherapy might have toxic levels that are unacceptable for astronauts. Some of the countermeasures developed for DOD/DHS are aimed at mitigating acute radiation syndromes, but not cancer risks. Furthermore, these radioprotectors are mostly for exposure to X- or gamma rays. This SBIR subtopic solicits specifically proposals to evaluate the radioprotectors that have been proven effective in mitigating biological impacts of X- or gamma rays for space radiation applications.

Relevance / Science Traceability:

This subtopic seeks technology development that benefits the Space Radiation Element of the NASA Human Research Program (HRP). Biomedical countermeasures are needed for all of the space radiation risks.

References:

The following references discuss the different health effects NASA has identified in regard to space radiation exposure:

- Evidence report on central nervous systems effects:Â https://humanresearchroadmap.nasa.gov/evidence/reports/CNS.pdf.
- Evidence report on degenerative tissue effects:Â https://humanresearchroadmap.nasa.gov/evidence/reports/Degen.pdf.
- Evidence report on carcinogenesis:Â https://humanresearchroadmap.nasa.gov/evidence/reports/Cancer.pdf.

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