# NASA SBIR 2020 Phase I Solicitation

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

**Lead Center: JSC**

**Technology Area: TA6 Human Health, Life Support and Habitation Systems**

### 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 and premature aging. With the current 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 re-purposing 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.

In Phase I of the project, the company should test radioprotectors or mitigators using protons or other charged particles at doses simulating exposure to space radiation. This testing can be done with cell models at the location of choice. Deliverables for the Phase I will be data generated from this exposure with the radioprotector selected. After contract award, due to the nature of this research, the contractor should immediately coordinate with their technical monitor for any special considerations for testing. In Phase II of the project, we would expect the company to expand testing radioprotectors or mitigators with combinations of different particles and energies that simulate the space radiation environment. Appropriate animal models, which may include chimeric humanized mouse models, should be used for the Phase II project.

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

**Expected TRL or TRL range at completion of the project** 5 to 8

**Desired Deliverables Description**

Phase I will test radioprotectors or mitigators using protons or other charged particles at space relevant doses. This testing can be done with cell models at the location of choice. After contract award, due to the nature of this research, the contractor should immediately coordinate with their technical monitor for any special considerations for testing.

Phase II will test effective radioprotectors or mitigators in space radiation simulated environments (HZE) to determine if they are able to minimize or prevent space radiation risks. Companies should provide a test plan for in vivo evaluation that describes the expected effect from the compound. Testing in NASA-owned space radiation simulation facilities will be an option for Phase II.

**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 CNS effects, cardiovascular diseases, 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. Countermeasures for adverse health effects from radiation exposure are of interest to Department of Defense (DoD), Department of Homeland Security (DHS) and the radiation therapy community as well.

**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.