NASA SBIR 2008 Phase I Solicitation

X13 Space Radiation

The goal of the NASA Space Radiation Research Program is to assure that we can safely live and work in the space radiation environment, anywhere, any time. Space radiation is different from forms of radiation encountered on Earth. Radiation in space consists of high-energy protons, heavy ions and secondary products created when the protons and heavy ions pass through spacecraft shielding and human tissue. The Space Radiation Program Element, within the Human Research Program uses the NASA Research Announcement as a primary means of soliciting research to understand the health risks and reduce the uncertainties in risk projection; however, there are areas where the SBIR program contributes. Specific areas where SBIR technologies can contribute to NASAâ€™s overall goal include: reliable radiation monitoring for manned and unmanned spaceflight; and radiation damage imaging.Â

Subtopics

X13.01 Active Charged Particle and Neutron Radiation Measurement Technologies

Lead Center: ARC

Participating Center(s): JSC

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Areas of Interest: Charged particles (protons and heavy ions) and secondary radiations, such as neutrons, contribute the most significant fraction to the total dose-equivalent received by astronauts. At present, NASA has active detectors on International Space Station (ISS) that measure the microdosimetric quantities and the charge and energy spectra of the space radiation field. Neutron specific data are included as part of the microdosimetric measurements. For Exploration class missions, however, more compact and reliable active detection systems will be needed to make microdosimetric, charge, and energy measurements of the total space radiation environment. Advanced technologies (up to technology readiness level 4) are requested.

Subtopic Requirements/Needs:

Tissue Equivalent Microdosimeter

NASA has a need for small/low-mass/low-power microdosimeter to support Exploration class missions. The microdosimeter should be capable of performing single event microdosimetric measurements of tissue equivalent volumes with simulated diameters of 1-2 micrometers. The microdosimeter should be sensitive to lineal energies of 0.2 - 1000 keV/micron. Design goals for mass and volume should be 2 kg and 2000 cm^3, respectively. The microdosimeter should be able to measure charged particles and neutrons in ambient conditions in space (0.01 mGy/hr) and during a large solar particle event (100 mGy/hr). The time resolution of the lineal energy measurements should be less than or equal to 1 minute.

Charged Particle Spectrometer

Of particular interest are compact real-time detection systems that can measure charge and energy spectra of protons and other ions (Z = 2 to 26) and be sensitive to charged particles with LET of 0.2 to 1000 keV/mm. For Z less than 3, the spectrometer should detect energies in the range 30 MeV/n to 400 MeV/n. For Z = 3 to 26, the spectrometer should detect energies in the range 50 MeV/n to 1 GeV/n. Design goals for mass and volume should be 2 kg and 3000 cm^3, respectively. The spectrometer should be able to measure charged particles at both ambient conditions in space (0.01 mGy/hr) and during a large solar particle event (100 mGy/hr). The time resolution should be less than or equal to 1 minute. The spectrometer shall be able to perform data reduction internally and provide processed data.

Neutron Spectrometer

Systems are needed specifically to measure the neutron component of the dose and provide the neutron dose-equivalent in real time. Of interest would be compact active monitoring devices that could measure neutron energy spectra. The principal energies of interest are neutrons from 0.5 MeV to 150 MeV. The spectrometer should be able to measure neutrons at ambient conditions such that proton/ion veto capability should be approaching 100% at solar minimum galactic cosmic radiation (GCR) rates. The spectrometer should be able to measure ambient dose equivalent of 0.02 mSv in a 1 hour measurement period, using ICRP 74 (1997) conversion factors. Design goals for mass and volume should be 5 kg and 6000 cm^3, respectively. The spectrometer shall store all necessary science data and unfolding/processing algorithms shall be determined and provided for post measurement data evaluation.

Phase 1 Requirements: Expected deliverable for Phase 1 is a detailed report that (1) establishes proof of concept; (2) addresses the scientific, technical and commercial merit and feasibility of the proposed technology and its relevance and significance to one or more NASA needs within the Solicitation; and (3) provides a preliminary strategy that addresses key technical, market, business factors, demonstration of the proposed innovation, and its transition into products for NASA mission programs and other potential customers.

X13.02 Technology/Technique for Imaging Radiation Damage at the Cellular Level

Lead Center: JSC

New quantitative techniques need to be developed in order to assess astronautsâ€™ exposure to space radiation. Charged particles (protons and heavy ions) are of major concern for health risks because they cause chromosome damage. Current methods for measuring space radiation chromosome damage are time consuming and have limitations in sensitivity and accuracy. The Space Radiation Element within the Human Research Program seeks a sensitive, accurate method for assessing chromosome damage, while at the same time being less time consuming than current mFISH and mBand techniques.

Subtopic Requirements/Needs: Of particular interest are ground laboratory techniques using fluorescence in situ hybridization to detect various types of chromosome damage. The technique should be able to measure charged particle exposure at both ambient conditions in space (0.005 mGy/hr) and during a large solar particle event (1000 mGy/hr). The technique should be able to detect various types of chromosome damage such as inversions and deletions in various regions of chromosomes. The technique must be able to quantify chromosome abnormalities that persist after space flight.

Phase 1 Requirements: Phase 1 expectations include a report describing the fully developed concept with feasibility analyses and comparisons to existing methods.