



NASA SBIR 2008 Phase I Solicitation

X13.01 Active Charged Particle and Neutron Radiation Measurement Technologies

Lead Center: ARC

Participating Center(s): JSC

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 particles created when the protons and heavy ions pass through spacecraft and human tissue.

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 cm³, 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 cm³, 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 cm³, 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.