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 interact with matter such as a spacecraft, surface of a planet, moon or asteroid. NASA requires instruments that can reliably measure these radiations. For exploration class missions, there is extraordinary premium on compact and reliable active radiation detection systems to meet very stringent size and power requirements. NASA needs compact, low power, active monitors that can measure charged particle spectrum and flux separately from neutrons and other radiations. NASA also needs compact active neutron spectrometers that can measure the neutron component of the dose separate from the charged particles. Advanced technologies up to technology readiness level (TRL) 4 are requested in the following areas: Charged particle spectrometer that is capable of measuring charge and energy spectra of ions with energies, linear energy transfer (LET) characteristics, and dose-rate parameters specified here. Neutron spectrometer that is capable of measuring neutrons with energies, dose rates, and other performance parameters specified here.

Subtopics

**X15.01 Active Charged Particle and Neutron Measurement**

**Lead Center: ARC**

For exploration class missions, there is extraordinary premium on compact and reliable active radiation detection systems to meet very stringent size and power requirements. NASA needs compact, low power, active monitors that can measure charged particle spectrum and flux separately from neutrons and other radiations. NASA also needs compact active neutron spectrometers that can measure the neutron component of the dose separate from the charged particles. Advanced technologies up to technology readiness level (TRL) 4 are requested in the following areas:

**Charged Particle Spectrometer**

Measure charge and energy spectra of protons and other ions (Z = 2 to 26) and be sensitive to charged particles with linear energy transfer (LET) of 0.2 to 1000 keV/micrometer. 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 should be 2 kg and for volume, 3000 cm³. 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**

Measure neutron energy spectra in the range of 0.5 MeV to 150 MeV. Measure neutrons at ambient conditions such that proton/ion veto capability should be approaching 100% at solar minimum GCR rates; measure ambient dose equivalent of 0.02 mSv in a 1 hour measurement period, using ICRP 74 (1997) conversion factors; store all necessary science data for post measurement data evaluation. Design goals for mass and volume should be 5 kg and 6000 cm$^3$. 