NASA SBIR/STTR Technologies

S1.09-9261 - Next Generation Gamma/Neutron Detectors for Planetary Science.

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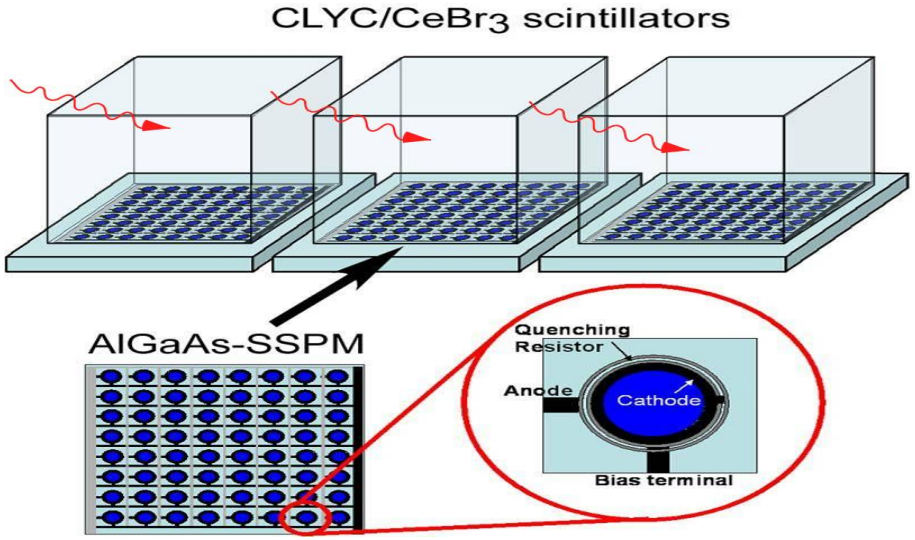
Identification and Significance of Innovation

Gamma ray and neutron spectroscopy are well established techniques for determining the chemical composition of planetary surfaces, atmospheres, and small cosmic bodies such as asteroids and comets. We propose to develop next generation gamma-ray and neutron detectors based on wide-band-gap solid-state photomultipliers (SSPM) coupled to emerging scintillation materials for gamma and neutron spectroscopic studies of planetary bodies. The wide band-gap SSPM is based on AlGaAs, which exhibits much lower dark noise, improved radiation hardness, and with aluminum concentration tailored to optically match the emission spectrum of emerging scintillation materials such as CLYC and CeBr3. The advantages of AlGaAs SSPM and the excellent properties of CLYC and CeBr3 scintillators make them a perfect match in the development of next generation gamma neutron spectrometers for not only studies of small cosmic bodies, but also for other NASA planetary science projects and missions.



Estimated TRL at beginning and end of contract: (Begin: 2 End: 5)

Technical Objectives and Work Plan

In the proposed Phase-I program, we will demonstrate the feasibility of next generation gamma/neutron detectors using wide-band-gap AlGaAs SSPMs coupled to CLYC and CeBr3 scintillators with the following technical objectives.
Provide evaluation results on the space radiation environment.
Optimize SSPM Geiger photodiode structures to provide lower dark noise.
Optimize quantum efficiency from 300 nm to 500 nm.
Design SSPM for relevant scintillation materials that are ideal for planetary science.
To demonstrate the feasibility of the concept, we will design and model the critical component of the nuclear detector, which is the elements of the AlGaAs SSPM. We will achieve the technical objectives by accomplishing the task listed below..:
Task 1. Simulation of radiation environment surrounding a small cosmic object.
Task 2. Design AlGaAs Geiger Photodiode structures.
Task 3. Simulation of AlGaAs Geiger Photodiode optical and electrical characteristic.
Task 4. Design prototype GPD and develop fabrication process.
Task 5. Characterize and analyze CLYC, and CeBr3 scintillators.
Task 6 Write Reports and Phase-II Proposal.

NASA Applications

The proposed innovative technology is a suitable component for many future gamma-ray and neutron spectrometer instruments to study chemical composition of cosmic objects and planetary surfaces. The nominal NASA application for this technology will be for a gamma-ray and neutron spectrometer. The complete spectrometer can be used for Earth science missions, planetary missions, exploration of small cosmic bodies such as asteroids and comets, satellite radio-imaging, and space exploration probes.

Non-NASA Applications

The proposed detectors have many applications in the science, homeland security, and medical fields. The AlGaAs SSPM, with its low dark noise and radiation hardness, is a direct replacement for photomultiplier tubes. The instrument can also be used for homeland security, science experiments, dosimeters for radiation therapy, and detectors in medical applications such as PET and SPECT.

Firm Contacts

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