NASA SBIR/STTR Technologies

Phase I: CMOS-based Neutron Spectroscopic Dosimeter (CNSD)

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Identification and Significance of Innovation

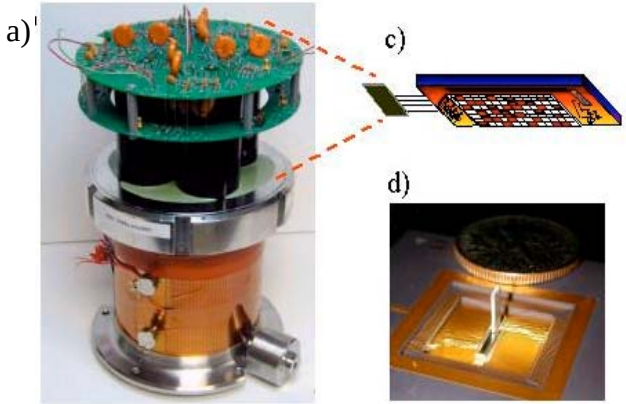
- CMOS solid-state photomultipliers (SSPM's) coupled to a neutron-sensitive gel scintillator and covered with anti-coincidence scintillator will provide a neutron spectroscopic dosimeter that can strongly reject charged particle and gamma-ray background events in NASA exploration class missions.
- Replacing the PMT's and its discrete readout components with an all-integrated CMOS SSPM (with its readout electronics integrated on the same chip) in the CHENSS spectrometer will provide a dosimeter that is compact, rugged, light-weight, non-hazardous and operates on low power.

Technical Objectives

- Prove that the CMOS-SSPM detectors can implement pulse-shape n/γ discrimination necessary for background rejection
- Prove that the current size of the SSPM detectors can be scaled up to readout the gelled scintillator and provide the necessary dynamic range in the desired neutron wide energy interval (0.5 – 150MeV)
- Develop a conceptual design to connect the CMOS-SSPM to the CHENSS detector and design the integrated processing electronics.

Work Plan

1. Determine the photodetector specifications necessary for use in the CHENSS.
2. Determine the time resolution of the CMOS-SSPM and its ability of performing pulse shape discrimination,
3. Test and compare the performance of the SSPM coupled to a gelled scintillator prototype to that of a PMT,
4. Investigate performance of large-area SSPMs,
5. Design integrated processing concept for a combined SSPM/CHENSS,
6. Write reports and Phase-II proposal.



a) Photograph of the housing for the visco-elastic gell-scintillator and its 4 photomultiplier tubes, c) Conceptual design of the ultra-compact CMOS-SSPM chip with its integrated readout electronic components, d) Photograph of a 100-pixel CMOS-SSPM prototype on an elongated silicon die with a peace of a standard scintillator on the top (in white). A large-area CMOS-SSMP chip will replace the PMT's and their discrete readout electronics in the CHENSS configuration. The CHENSS spectrometer is proven to efficiently detect neutrons with different energies up to 100 MeV with excellent background rejection capability [1, 6].

NASA and Non-NASA Applications

The proposed compact, rugged, non-hazardous and fast neutron spectroscopic dosimeter can be used in exploration class missions and in creating a radiation monitoring network including satellites and earth-base research in NASA labs. Non-NASA applications include: National Labs, fast neutron facilities, accelerator driven systems, the DHS SNM verification at the ports of entry, the IAEA, environmental monitoring, fast neutron medical therapy, commercial satellite protection. Non-NASA applications include neutron detection and imaging for reactors and homeland security.

Contacts

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