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Development, Characterization, and Testing of a Thermal Neutron Detector Based on ZnS:Ag Scintillators and Wavelength-Shifting Fibers

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Abstrac

The continuous increase in the price of helium-3 has made neutron detectors based on this isotope increasingly expensive, directly contributing to higher costs for experiments that require their use [1]. In this context, the present work addresses the development and characterization of a thermal neutron detector based on a silver-doped zinc sulfide scintillator (ZnS:Ag) coupled to silicon photomultipliers (Multi-Pixel Photon Counters, MPPCs).

During the course of this work, the performance of the MPPCs was characterized through LED excitation tests, allowing the gain of each device to be determined. In addition, a coincidence-based signal discrimination method was implemented to reduce the thermal noise inherent to MPPCs. Furthermore, the arrival time of the signals produced by the incidence of blue LED light on the optical fiber used for light collection was investigated.

Finally, the detector response was evaluated using an open alpha-particle source, gamma source, and an americium-beryllium neutron source, with the aim of developing a discrimination method capable of distinguishing neutron-induced events from those produced by other types of radiation incident on the detector. As future work prior to the symposium, the neutron detection efficiency will be evaluated using the americium-beryllium source in combination with moderating materials.

References

[1] D. A. Shea and D. Morgan, The Helium-3 Shortage: Supply, Demand, and Options for Congress, Tech. Rep. R41419 (Congressional Research Service, 2010) cRS Report for Congress.