

A SiPM-Based Ultracold Neutron Depolarization Monitor

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Silicon photomultipliers, also known as SiPMs, are sensitive photon detectors, comparable to photomultiplier tubes, that are useful in resolving single photons in very dark environments. As such, they have potential application in the UCN τ + experiment being conducted at Los Alamos National Laboratory. In this experiment, ultracold neutrons are confined by gravity and magnetic gradients from an array of permanent magnets. This arrangement allows for measurement of the mean free neutron lifetime. As the neutrons evolve in this system, they occasionally depolarize, causing the neutrons to be drawn towards the magnets. These depolarization events create a systematic error when determining the neutron lifetime. To evaluate this systematic effect, a scintillating material, thinly coated with Boron-10, can be placed over the magnets to capture these depolarized neutrons, resulting in the emission of photons from the scintillator. The goal is to detect the emitted photons and empirically quantify limits on the rate at which depolarization occurs. However, as nothing can be placed in the volume of trapped neutrons, optical elements must be used to capture photons from about a meter away. Expectations for the performance of this detector based on the characterization of a prototype will be presented.