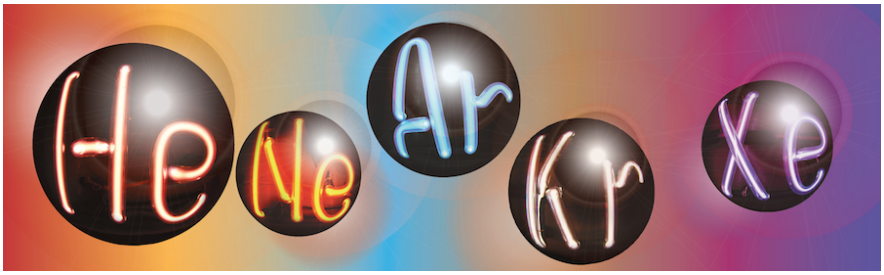

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Long-term performance of VUV-sensitive silicon photomultipliers (SiPM) for large-scale liquid xenon detectors

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Cryogenic, vacuum-ultraviolet (VUV)-sensitive silicon photomultipliers (SiPMs) are being developed for next-generation experiments to search for neutrinoless double beta decay like nEXO. nEXO is a time-projection chamber enriched to 90% Xe-136 designed to search for neutrinoless double-beta decay with a projected half-life sensitivity of 1.35*10ˆ28 years over a 10-year lifespan. Achieving this sensitivity requires high efficiency VUV SiPMs to detect the 175 nm xenon scintillation light, motivating a rigorous characterization of their long-term performance under cryogenic conditions. We present selected results from a multi-year study of a single Fondazione Bruno Kessler HD3 VUV SiPM in a kilogram-scale liquid xenon cryostat with precise temperature control at UMass Amherst. This setup allows for the characterization of the SiPM through IV curves, the measurement of single photon event (SPE) spectra, and the measurement of xenon scintillation light. This enables the characterization of SiPM properties such as gain, breakdown voltage, correlated avalanches, and photon detection efficiency across three mediums: vacuum, gaseous nitrogen, and liquid xenon. These conditions directly replicate the nEXO detector environment, providing essential validation of SiPM longevity and performance for the experiment ' s decade-scale lifetime.

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