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Investigating SiPM PDE change from high VUV photon exposure in LXe detectors

Silicon photomultipliers (SiPMs) are the photosensors of choice for many future liquid xenon (LXe) scintillation detectors, yet their long-term stability under intense vacuum-ultraviolet (VUV) exposure remains poorly characterized. During data taking, the MEG II experiment observed a degradation of the SiPM photon detection efficiency (PDE) for the ~ 175 nm LXe scintillation channel, with a much less significant degradation in the response to visible calibration light. This effect has so far not been reproduced in dedicated laboratory measurements, motivating a controlled in-beam study. Of particular importance, as next-generation LXe experiments will instrument thousands of sensors for several years of run-time. To isolate the underlying mechanism, we will deploy spare MEG-production SiPMs, FBK HD3 devices, and new generation Hamamatsu SiPMs which feature smaller SPADs and surface treatments developed to suppress degradation. These measurements will take place in the π M1 beam at PSI in November 2026. The delivered VUV dose will be constrained through detailed optical simulations, and absolute VUV and visible PDE, correlated noise, and light emission will be measured before and after exposure, using the testing facilities at TRIUMF Lab. This presentation will outline the effect, the measurement program, and preliminary testing results.

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