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Low energy calibration and characterization of solid-state dark matter detectors

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A major hurdle in searches for sub-GeV particle-like dark matter is demonstrating sufficiently low energy detection thresholds in order to detect recoils from light dark matter particles. Many detector concepts have been proposed to achieve this goal, which often include novel detector target media or sensor technology. A universal challenge in understanding the signals from these new detectors and enabling discovery potential is characterization of detector response near threshold, as the calibration methods available at low energies are very limited. We have developed a system capable of cryogenic optical beam steering for robust calibration of any photon-sensitive detector over the energy range of 0.06 - 5eV. This system can be used to scan over a detector and deliver short, collimated pulses of small numbers of photons in a way that limits parasitic backgrounds, allowing for exploration of a variety of science targets including position sensitivity of detector configurations, phonon transport in materials, and the effect of quasiparticle poisoning on detector operation. I will present the design overview and specifications, along with current status of the testing program involving mKID and qubit devices.

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