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Characterization of Novel Superconducting Quantum Sensors for Dark Matter Detection

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A significant challenge in the detection of meV-scale rare events 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 is characterization of detector response near the detection threshold, as the calibration methods available at low energies are very limited. We have developed a method of cryogenic optical beam steering that can be used to generate O(μs) pulses of small numbers of photons over the energy range of 0.1 - 5eV and deliver them to any location on the surface of a superconducting device with time and energy features comparable to expected signals. This allows for robust calibration of any photon-sensitive detector, enabling 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. In this talk, I will present the operating principles and results of this optical beam steering and pulse delivery system, and discuss the implementation of this technology for various novel sensor technologies such as HVeV detectors, MKIDs, and SQUATs (superconducting quasiparticle amplifying transmons).

Mini Symposia (Invited Talks Only)

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