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Design and Performance of a Cryogenic THz Calibration System for Ultra-Sensitive Detectors

Tuesday 7 October 2025 17:45 (15 minutes)

The calibration of ultra-sensitive THz/meV detectors in cryogenic environments is a significant challenge, as standard fiber optics absorb THz radiation and tunable sources are limited. A system is being developed using a photomixer and hollow circular waveguides to deliver tunable frequency THz photons to cryogenic sensors. This work is motivated by the need to calibrate superconducting quasiparticle-amplifying transmons (SQUATs), which are sensitive to single THz photons and meV phonons, and are utilized in searches for axion and other low-mass dark matter candidates and neutrinos.

This poster reports on the progress of a calibration setup to validate photomixer performance and test waveguide transmission. Initial room-temperature bench testing focused on characterizing capillary waveguides, alignment, and noise mitigation. We also report on the progress of our first cryogenic tests, a crucial milestone, as the long-term goal is to use this calibration system as a reliable THz source for the calibration of SQUATs in a dilution refrigerator. This work will additionally allow the full calibration of the Broadband Reflector Experiment for Axion Detection (BREAD).

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