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Development of microwave multiplexed readout for athermal phonon TES-based detectors

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The scalability of sub-Kelvin superconducting sensors is generally limited by their associated superconducting readout electronics, motivating multiplexing schemes which reduce the system complexity, cost, and thermal load on the refrigerator. Microwave SQUID multiplexing, which inherently has access to ˜100x the operation bandwidth of alternative schemes, is a compelling candidate for future advanced readout. It combines the inherent frequency-division multiplexing capability of kinetic inductance detectors with the ability to independently optimize the sensor array, enabling broad compatibility with a variety of TES and MMC sensors. Here, we report on new work to develop a microwave SQUID multiplexer for sub-eV threshold TES calorimeters suitable for direct detection searches for keV - GeV dark matter. A unique challenge with any readout scheme of such sensors is the avoidance of sub-fW parasitic power dissipated in the TESs, which can saturate them. We describe efforts to model, measure, and mitigate the sources of parasitic leakage in microwave SQUID readout as a first step to developing a scaling path towards a future experiment with thousands of TES sensors.

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