

Progress Towards sub-eV Phonon and Photon Sensitivity with Athermal Phonon Detector for Light Mass Dark Matter Searches and Other Applications

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Searching for dark matter in the 10meV-100MeV mass range requires sensitivity to small energy depositions. In particular, sensitivity to a single optical phonon quanta in Sapphire ($\sim 50\text{meV}$) or 2 roton quanta in superfluid He would enable searches deep into an entirely unexplored parameter space. Over the past year, we've made significant progress towards these goals. In particular, we've developed a 45cm^2 Si athermal phonon detector with a baseline energy resolution of 3.5eV . After scaling for size, this device represents an order of magnitude leap in sensitivity compared to previously measured sensitivities. Analysis is currently ongoing on a 33 gd above ground light mass dark matter search using this prototype. Additionally, we've begun testing the transition edge sensor test structures for the following generation prototype design. Measured baseline resolution was 50meV ; after scaling for size this device also represents nearly an order of magnitude improvement compared to currently available world leading devices.

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