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# Progress on a KID-Based Phonon-Mediated Dark Matter Detector

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We report on the status of our development of dark matter detectors in which the recoil energy deposited in a crystalline substrate is sensed via the absorption of athermal phonons in kinetic inductance detector (KIDs) (cf. Moore et al 2012, Cornell et al 2014, Chang et al 2018). KIDs are highly multiplexable, offering the prospect of tens or even hundreds of phonon sensors per kg-scale substrate. Such finely pixelated imaging of the phonon signal has the potential for extremely high-fidelity position reconstruction, in particular reconstruction of both radial and z position as well as reduced misreconstruction of surface events as events in the bulk substrate fiducial volume. Our design currently consists of 80 Al KIDs coupled to a Nb coplanar waveguide feedline on a 75-mm diameter, 1-mm thick silicon substrate, a design straightforwardly scalable to thicker substrates (1 cm and larger) and thus to 0.1-1 kg substrate mass. To date, we have demonstrated high fabrication yield, well-controlled resonator frequency placement, and good agreement of resonator behavior with Mattis-Bardeen theory. We are using a novel readout pulsing technique to generate energy deposition in a controlled, localized fashion (see Y.-Y. Chang et al, this conference) in order to measure energy resolution and quasiparticle lifetime. We are engaged in efforts to reduce incident blackbody radiation in order to obtain maximal quasiparticle lifetimes, of order 1 ms and longer, with the expectation of demonstrating an energy resolution below 100 eV. Near-term future work will include integration with a quantum-noise-limited kinetic inductance parametric amplifier and development of an alternate design optimized for energy resolution rather than position reconstruction.

## Less than 5 years of experience since completion of Ph.D

Y

## Student (Ph.D., M.Sc. or B.Sc.)

Y

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