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KID-based phonon-mediated (KIPM) detectors

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KID-based phonon-mediated (KIPM) detectors have two features that make them attractive for dark matter searches and CEvNS studies: 1) the massive multiplexability of KIDs enables the position resolution necessary for nuclear recoil discrimination; and 2) a variety of amplifier-based and KID-specific improvements chart an attainable path forward to sub-eV energy resolution. We report on the progress of two different KIPM detector architectures optimized for each of these goals. Architecture 1: a 9-gram 80-KID KIPM detector demonstrates clear dependence of pulse shape on KID location relative to event position. Furthermore, the non-uniformity in the amplifier-limited energy resolution among the KIDs in this device is amenable to improved RF engineering, which will be necessary to obtain sub-eV amplifier-limited resolution on energy absorbed in each KID. Architecture 2: a 1-gram, single-KID KIPM detector has shown a resolution of 2.5eV on energy absorbed in the KID (albeit with low phonon collection efficiency). Future devices that recover the 10%-level efficiency seen in earlier devices could then achieve eV-scale resolutions. Finally, we will present the result of a KIPM detector whose readout was amplified by a kinetic inductance traveling wave amplifier to achieve few-quanta noise and 5x improvement in amplifier-limited resolution.

Early Career

No

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