Phonon-mediated KIDs as light detectors for rare event search: the CALDER project

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Background suppression plays a crucial role in experiments searching for rare events, like neutrino-less double beta decay (0nDBD) and Dark Matter interactions.
Bolometers, that are among the most competitive devices in this field, would largely benefit from the development of ultra-sensitive light detectors, as the combined read-out of the bolometric and light signals enables the particle identification.
The CALDER collaboration is developing cryogenic light detectors that will match the requirements of next generation experiments: noise lower than 20 eV, large active area, wide temperature range of operation, ease in fabricating and operating a thousand of channels.
For this purpose, we are exploiting the excellent energy resolution and the natural multiplexed read-out provided by Kinetic Inductance Detectors (KIDs). These devices can be operated in a phonon-mediated approach, in which KIDs are coupled to a large insulating substrates in order to increase the active surface from a few mm^2 to 25 cm^2.

We will present the results obtained with the first prototypes based on aluminum LEKIDs, illuminated with a 57Co X-ray source and an optical fiber. Best detectors reach a baseline sensitivity of 80 eV.
Thanks to the deep understanding of signal propagation and pulse shape, we are able to perform an absolute calibration of the device with a typical accuracy better than 15 %. The estimated overall efficiency of the detector is about 20 %, remarkable for an indirect approach.
We will compare our results with the expected resolution and we will describe the improvements we are implementing, using different geometries and superconducting materials (e.g. TiN, Ti/TiN, etc.), in order to reach the goal of the project.