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Lumped element kinetic inductance detectors on CaF2 for neutrino-less double-beta decay and spin-dependent dark matter search

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Superconducting detectors (SCDs) are widely used in astroparticle physics experiments such as dark matter search and cosmic microwave background experiments. Kinetic Inductance Detector (KID) is one of the promising SDCs since KID has several technical advantages: very low fundamental noise, easy fabrication, and high scalability with frequency domain multiplexing. KID consists of microwave resonance circuit with superconducting film on substrate. Any energy deposit will break apart Cooper pairs in the superconducting film, resulting in an excess quasi-particle population. The change in the population increases kinetic inductance in the resonance circuit. The signal is readout from the change of the resonance.
Generally, silicon is used as substrate. We implement lumped element KIDs (LEKIDs) in CaF2 crystal which is used as substrate. CaF2 is a novel target for neutrino-less double-beta decay and spin-dependent dark matter studies, since 48Ca is one of the double-beta decay nuclei and 19F is sensitive to spin-dependent elastic scattering with dark matter.

LEKID on CaF2 is cooled to 300mK with 3He sorption cryocooler. The resonance is found in O(1GHz). Thus, we confirmed that LEKID on CaF2 worked well. This result opens a new possibility in the next generation of astroparticle physics experiments

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