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Development of Microwave Kinetic Inductance Detectors for phonon and photon detections

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We present our recent developments of Microwave Kinetic Inductance Detectors (MKIDs) for phonon and photon detections.
An MKID is a type of superconducting detectors. Cooper-pair breaking caused by deposited energy changes the kinetic inductance of the superconductor. Consisting of LC resonators formed by a thin superconducting metal layer, it detects the energy by sensing the change of the inductance. By using the MKIDs we can readout the detectors with frequency-domain multiplexing.

Since the bound energy of Cooper-pairs is order of milli-electron volt and the detectors are operated at low temperature of less than 1K, MKIDs have high energy resolutions and low noise levels. The highly sensitive detectors can be applied to measurements that require the detection of very week signals, for instance dark matter search. We are developing MKIDs that are formed with the combination of two metal layers of Al and Nb. By using two superconducting metal layers, we can confine the quasi-particles in a certain region due to the difference of the energy gaps and expect an increase of the sensitivity.

We have developed Nb/Al MKIDs for the detections of photons and phonons. For the former, we aim to apply the MKIDs to a He scintillation detector for a search of light dark matter with liquid He TPC. The latter would be applied not only to the dark matter search but also to X-ray detections with the high energy resolution and a high acceptance for future material science.

Summary

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