Toward a millimeter-imaging spectrometer using magnetic field tunable kinetic inductance detectors

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Abstract

We report the on going development of a millimeter-imaging spectrometer based on kinetic inductance detectors (KIDs). KIDs are a special implementation of superconducting resonators [1]. They are planar resonant circuits consisting of superconducting thin films deposited on an insulating substrate. The principle of photon detection is to monitor the resonance frequency shift, which is proportional to the incident power. The incident radiation breaks Cooper pairs, creating quasiparticles and modifying the kinetic inductance, resulting in a shift of the resonance frequency. To date, thousands of KIDs are being implemented in ground-based cameras used for millimeter-wave observations in astrophysics [2,3]. To achieve spectroscopies capabilities we tune the spectral response of KIDs using a magnetic field. Figure 1 presents the first demonstration of the optical response of the KID can be modulated under the influence of a varying magnetic field [4].

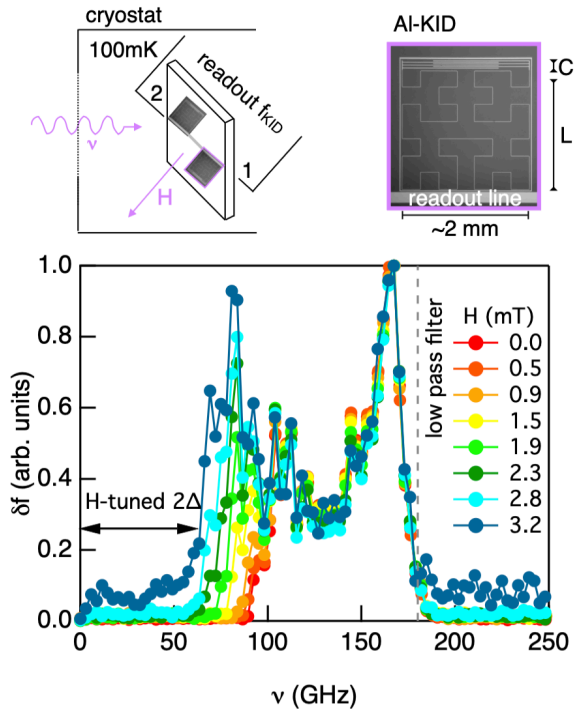

Fig.1 : Magnetic field tunable response of KID. Top: experimental setup and picture of a KID. The magnetic field is applied perpendicular to the array by superconducting coil. Bottom: Spectral response of KID exposed to different magnetic fields: frequency shift of KID as a function of the incident optical frequency. The low optical cut-off frequency corresponds to the 2Δ superconducting gap, which varies as a function of the magnetic field.

References :

1. P. K. Day et al, *Nature* 425, 817 (2003).
2. NIKA2 collaboration, *Astronomy & Astrophysics* 637, A71 (2020).
3. A. Monfardini et al, *J Low Temp Phys* 209, 751–757 (2022).
4. F. Levy-Bertrand et al, *Applied Physics Letters* 126, 042602 (2025).

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