Exploring THz electrodynamics of superconductors with Kinetic Inductance Detectors

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Kinetic Inductance Detectors (KIDs) are state-of-the-art detectors used for millimeter wave observations in astrophysics. They are planar resonant circuits made of superconductors deposited on an insulating substrate. The photon detection principe consists in monitoring the resonance frequency shift that is proportional to the incident power [1].

We adapt the instrumentation for astrophysics observation based on KIDs [2] to explore the electrodynamics of superconductors. We measured at 100mK from 0GHz up to 300GHz with a resolution of 1GHz the electrodynamics of granular aluminum superconductors. From pure aluminum to insulating composition the superconducting critical temperature of granular aluminum presents a dome shape. The study has shown the emergence of sub-gap collective modes in the vicinity of the maximum of the superconducting dome [3]. We interpret these modes as phase fluctuations.

[1] P. K. Day et al, Nature, vol. 425, 817 (2003).
[2] A. Monfardini and G. Lagache, Nature Astronomy 5, 970 (2021).
[3] F. Levy-Bertrand et al, Phys. Rev. B 99, 094506 (2019).