

ANTENNA-COUPLED MICROWAVE KINETIC INDUCTANCE DETECTORS

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We report on the development of microwave kinetic inductance detectors (MKIDs) coupled to planar antennas for submillimeter wavelengths. The MKID is a relatively new type of superconducting photon detector which is applicable from millimeter-wave frequencies to X-rays. Photons are absorbed in a superconductor, producing quasiparticle excitations, which change the surface reactance (kinetic inductance) of the superconductor. The changes in kinetic inductance are monitored using microwave high-Q thin-film superconducting resonators. We have demonstrated the detection of submillimeter-wave power with an MKID using a planar antenna and microstrip coupling. In our coupling scheme, power from a slot array antenna is transmitted along a niobium microstrip line to an MKID based on a quarter-wavelength coplanar waveguide transmission line resonator. The microstrip line overlaps the resonator over a short distance at its shorted end to transfer power to the resonator. We have fabricated single pixel devices that use a dual polarization antenna designed for 350GHz, as well as small arrays of single polarization devices designed for millimeter-wave frequencies. We have conducted measurements of the efficiency of these detectors using a thermal radiation source located inside the cryostat with the detector. Measurements of antenna beam-patterns and frequency response were conducted using a cryostat with a window. Because the MKID is particularly amenable to frequency-domain multiplexing, with likely detector multiplexing factors of $\sim 10^3$ or more per cryogenic amplifier, these detectors are well suited for use in large arrays. We discuss the sensitivity of these detectors and the potential of antenna-coupled MKID arrays for ground and space-based millimeter/submillimeter imaging.

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