5000 pixels LEKID Array for Antarctic Terahertz Telescope at 850-GHz

Abstract

The Antarctic THz Telescope project (ATT850) aims to explore the sub-millimeter sky at 850 GHz from a high-altitude site at Dome Fuji (3810 m, Antarctica). The primary scientific objective is to survey dust emission at high frequencies, enabling the determination of dust temperature and the measurement of redshift for distant galaxies (z $\approx$ 5–8), close to the peak of their spectral energy distribution (SED). Achieving these goals requires photon-noise-limited detectors to take full advantage of the extremely low background conditions, estimated at 10^{-11} W/pixel at Dome Fuji.

To meet these challenges, we develop superconducting Lumped Element Kinetic Inductance Detectors (LEKIDs) fabricated on 130 μm silicon wafers. The pixels are designed to be sensitive to dual polarization around 850 GHz, on a 130 GHz bandwidth, using a Hilbert curve inductor geometry. A first prototype, fabricated on a 2-inch wafer and tested in the laboratory in 2024, consists of 224 pixels with a 1 mm pitch and demonstrated an NEP of $2 \times 10^{-17}\ W/\sqrt{Hz}$, compatible with photon-noise-limited operation at Dome Fuji.

Building on these results, a new large-format array is being developed on a 4-inch wafer to scale up to thousands of pixels. This new array includes 5028 pixels distributed over 8 feedlines and is currently being tested in laboratory conditions at 100 mK using a dilution fridge. These developments represent a significant step toward the realization of large, photon-noise-limited detector arrays for future THz astronomical observations.

Key-words

Superconductors, Kinetic Inductance Detectors, Interstellar Dust emission, High redshift galaxies, Photon-noise limited