

HEAT: The High Elevation Antarctic Terahertz Telescope

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Abstract— KAPPA (the Kilopixel Array Pathfinder Project) is an effort to develop key technologies to enable the construction of coherent heterodyne focal plane arrays in the terahertz frequency regime with ~1000 pixels. The current state-of-the-art pixel count for coherent terahertz focal plane arrays is ~100 pixels (the Supercam 350 GHz array with 64 pixels). The leap to ~1000 pixels requires several key technological problems to be tackled before the construction of such a focal plane is possible. While the previous generation of arrays used 1D integration of mixer elements into a linear array module, kilopixel instruments will require 2D integration, as has been done with incoherent terahertz and infrared detectors. Over the next three years, the KAPPA project will develop a small (16-pixel) 2D integrated heterodyne focal plane array for the 660 GHz atmospheric window as a technological pathfinder towards future kilopixel heterodyne focal plane arrays in the terahertz frequency regime. KAPPA will use SIS devices fabricated on SOI membranes with beam lead alignment and connection features, designed for high yield and fast installation. A SiGe low noise amplifier with on-chip bias tee will be integrated directly into the mixer block immediately adjacent to each mixer. This amplifier has been designed to yield adequate gain and low noise temperature, while dissipating less than 2mW of power. The SIS and LNA devices will be mounted in a 2D integrated metal micromachined mixer array consisting of a backshort block containing the SIS device and LNA, and a horn block using drilled smooth-wall feedhorns. Magnetic field will be delivered to the devices via compact, permanent magnets embedded in the horn block. We will also develop cryogenically compatible IF flex circuits to replace individual semi-rigid coaxial lines for IF signal transmission. Once completed, this instrument will demonstrate the critical technologies necessary to construct coherent arrays approaching 1000 pixels for large single-dish THz telescopes like CCAT and SPT.