The Kilopixel Array Pathfinder Project (KAPPa), a 16 pixel integrated SIS focal plane array

C. E. Groppi[1*], C. H. Wheeler[1], H. Mani[1], S Weinreb[2], D. Russell[2], J. Kooi[2], A. Lichtenberger[3] and C. Walker[4]

1 Arizona State University, Tempe, AZ, 85287 USA*
2 California Institute of Technology, Pasadena, CA 91125
3 University of Virginia Microfabrication Laboratories, Charlottesville, VA 22904
4 University of Arizona, Tucson, AZ 85721 USA
* Contact: cgroppi@asu.edu, phone +1-480-965-6436

***Abstract*—KAPPa (the Kilopixel Array Pathfinder Project) is developing key technologies to enable the construction of heterodyne focal plane arrays in the terahertz frequency regime with ~1000 pixels. The leap to ~1000 pixels requires solutions to several key technological problems before the construction of such a focal plane is possible. The KAPPa project will develop a small (16-pixel) 2D integrated SIS focal plane array for the 675 GHz atmospheric window as a technological pathfinder towards future kilopixel heterodyne focal plane arrays. 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. We will report on the design and testing of a prototype pixel cell with integrated SiGe LNA and permanent magnet. This single pixel prototype will validate the KAPPA design approach before proceeding to the construction of the 16 pixel focal plane. In particular, this mixer is designed to accept both permanent magnets and an electromagnetic coil, allowing careful comparison of performance with the identical SIS chip and magnet geometry.**