P8F

Microwave kinetic inductance detector (MKID) camera testing for submillimeter astronomy

N.G. Czakon[1*], P.K. Day[2], J.-S. Gao[1], J. Glenn[3], S. Golwala[1], H. LeDuc[2], P.R. Maloney[3], B. Mazin[4], D. Moore[1], O. Noroozian[1],H. T. Nguyen[2], J. Sayers[1], J. Schlaerth[3], J. E. Vaillancourt[1], A. Vayonakis[1], and J. Zmuidzinas[1]

*1 California Institute of Technology *, Pasadena, CA 91125*

2 Jet Propulsion Laboratory, Pasadena, CA 91109

3 University of Colorado, Boulder, CO 80309

4 University of California, Santa Barbara, CA 93106

* Contact:czakon@caltech.edu, phone +1(626)3954246

***Abstract*—State-of-the-art incoherent submm- and mm-wave detectors regularly achieve background limited performance. The only means to increase sensitivity further is to increase focal plane pixel counts. Microwave kinetic inductance detectors (MKIDs) provide a cost-effective, easily scalable means to produce fully lithographic background-limited kilopixel focal planes. We are constructing a MKID-based camera for the Caltech Submillimeter Observatory with 576 spatial pixels each simultaneously sensitive in 4 bands at 750, 850, 1100, and 1300 microns. Each spatial pixel consists of an octave-bandwidth phased-array slot-dipole antenna to define the radiation pattern. The antenna output is coupled to four independent MKIDs via parallel photolithographic band-defining filters corresponding to the four bands. The full focal plane will consist of 16 tiles of 36 spatial pixels each. Each tile will use a single coplanar waveguide to couple the 144 quarter-wave microwave resonators to a single cryogenic amplifier.**

The novelty of MKIDs has required us to develop new techniques for detector characterization. To determine optical loading, measurements of lifetime were made by coupling energy into the resonators both optically and by driving the third harmonic of the resonator. The two techniques yield equivalent lifetime measurements with values in the few microsecond range under optical loading. Optical loading has also been determined using internal Q measurements, which range between 15,000 and 30,000 for our resonators. Quasiparticle lifetime and resonator Qs have been measured for detector bath temperatures between 200 mK and 400 mK. Spectral bandpasses have been measured for the 850 and 1300 micron bands using a Fourier transform spectrometer. Additionally, beam maps have been taken and we have found that they conform to expectations. The same device design has been characterized on both sapphire and silicon substrates.

First-astronomical light was obtained with these devices in 2007 and a second engineering run is planned for mid-2009. The full camera will be commissioned at the CSO during 2010 and will become a facility instrument. We report on the status of the cryogenics, optics, detector design, and electronic readout system of the final camera.