Recent work on a 600 pixel 4-band microwave kinetic inductance detector (MKID) for the Caltech Submillimeter Observatory

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We report recent progress on a ~600 spatial pixel 4-band (750, 850, 1100, 1300 microns) camera (MKIDCam) for the Caltech Submillimeter Observatory (CSO). This work is based on extensive previous work on a 16 pixel 2-color demonstration camera tested at the CSO (see poster by A. Vayonakis et al.).

Our camera focal plane will make use of three novel technologies: Microwave kinetic inductance detectors (MKID), photolithographic phased array antennae, and on-chip band-pass filters. An MKID is a highly multiplexable photon detector that uses the change in surface impedance of a superconducting quarter-wave coplanar-waveguide (CPW) resonator to detect light. The resonator is weakly coupled to a CPW feed line. The amplitude and phase of a microwave probe signal (at the resonance frequency) transmitted on the feed line past the resonator changes as photons break cooper pairs. Hundreds to thousands of resonators tuned to slightly different frequencies may be coupled to a single feed line resulting in an elegant multiplexing scheme to read out a large array. Our phased array antenna design obviates beam-defining feed horns. On-chip band-pass filters eliminate band-defining metal-mesh filters. Together, the antennae and filters enable each spatial pixel to observe in all four bands simultaneously. Due to the large number of pixels the step and repeat capability of our photolithography system will be used to reduce the number of required masks and the field size in the fabrication process.

In order to reduce frequency noise due to fluctuations in the dielectric constant of the substrate, we are exploring new resonator designs that use interdigitated capacitors to lower electric field concentrations around the resonator lines.

Readout will be done with software-defined radio and will use microwave IQ modulation which has been demonstrated at the CSO. We are working on the implementation of an improved design using sixteen X5-400M commercial FPGA boards operating at room temperature.