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# A Dual-Polarization TES Bolometer Detector for CMB B-pol Measurements

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***Abstract*— Investigation of the Cosmic Microwave Background (CMB) has provided strong constraints on the composition, geometry, and history of the universe. The CMB polarization signal represents the next frontier of cosmological discovery. The existence of B-modes in the CMB polarization signal, expected at the level of 10–100 nK, will indicate the presence of gravitational waves in the primordial universe and reveal the energy scale of inflation. Superconducting Transition Edge Sensor (TES) bolometer detectors operating in the millimeter-wavelength range offer the sensitivity required to investigate the CMB B-mode signal.**

**We have developed a polarization sensitive TES bolometer detector for deployment in a kilo-pixel array for observations of CMB polarization. Each pixel is assembled from two dies. Each die consists of a proximity-effect Mo/Au bilayer TES and a single dipole absorber, suspended on a thin strip of silicon nitride. Two dies offset by 90 degrees and mounted face to face with a spacing of ~10 μm create a dual-polarization assembly. The assemblies are mounted in single-mode round waveguide with a quarter-wave backshort, which permits the radiation pattern to be defined by a corrugated feedhorn.**

**This report reviews our design, the status of this technology, and our development effort. A variety of approaches to achieve the required low values of the thermal conductance to bath, G, were examined. Both diffusive and radiative or ballistic heat transport were observed in silicon nitride membranes at temperatures ~500 mK. The target G of 200 pW/K was achieved using physically viable strip configurations only tens of microns wide by millimeters in length. Characterization of prototypes, including measurements of the detection bandwidth, RF bandwidth cross-polarization, noise, and detector stability is discussed. Initial results indicate an optical bandwidth exceeding 200 Hz and cross-polarization at the level of 2%, with background-limited noise suitable for ground-based observations.**