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Demonstration of a Kilopixel-scale multiplexing factor for TES bolometers using microwave SQUID readout

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The next generation of cosmic microwave background (CMB) imagers are nearly upon us. Large millimeter wave cryogenic receivers under development for the Simons Observatory, ALI-CPT, CCAT-prime, and BICEP array will each couple tens of thousands of transition-edge sensors (TES) onto the sky. These large sensor counts will be achieved by tiling multiple 150mm-diameter multichroic detector arrays into focal planes. The microwave SQUID multiplexer (μMUX) is a novel readout technique designed to address the complexities of reading out high detector wafer counts in densely tiled focal planes. The sensitivity, low cross-talk, extremely high multiplexing density of TES bolometers, and compact physical footprint make the μMUX well-suited for this goal. μMUX inductively couples the signal from TES bolometers to a frequency change in a quarter-wave resonator via a dissipationless rf-SQUID. Each multiplexing channel couples the TES to its own unique resonant frequency between 4-8 GHz. By closely spacing the resonant frequencies and coupling to a common CPW feedline, over 2000 TES bolometers may be read out on a pair of coaxial cables. We present the next iteration of the μMUX design, with a factor of two and three improvements in physical and spectral channel density, respectively. These resonators are nominally spaced 2 MHz apart, have a bandwidth of 100kHz, and have an input referred current noise of 35 pA/√Hz, which is well suited for a background-limited TES bolometer. Finally, we will present the latest results from a 2000 channel mux demonstration. These results will include discussions on readout noise, stability, yield, crosstalk, and TES-coupled performance.

Less than 5 years of experience since completion of Ph.D

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