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Development of frequency-domain readout of Transition Edge Sensor bolometers for the POLARBEAR-2 Cosmic Microwave Background

The POLARBEAR-2 Cosmic Microwave Background (CMB) experiment aims to observe B-mode polarization with high sensitivity to explore gravitational lensing of CMB and inflationary gravitational waves. We will build a receiver that has 7,588 antenna-coupled, polarization sensitive Transition Edge Sensor (TES) bolometers. The kilopixel arrays of multi-band polarization-sensitive pixels are necessary to achieve the high sensitivity and stringent control of systematic errors required by these science goals. For the large array's readout, we employ digital frequency-domain multiplexing and multiplex 32 bolometers through a single superconducting quantum interference device (SQUID).

An 8-bolometer frequency-domain multiplexed readout has been deployed on multiple experiments. Extending that architecture to 32 bolometers requires an increase in the bandwidth of the SQUID electronics. To achieve this, we have implemented Digital Active Nulling (DAN) on the digital frequency multiplexing platform. With DAN, digital feedback is calculated for each bolometer, extending the useful bandwidth of the SQUID amplifier. Another factor limiting the current bandwidth is parasitic inductance, which we have reduced in our new readout architecture. We will show frequency-domain multiplexing up to 3 MHz.

quote your primary experiment

POLARBEAR2

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