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Calibration System with Cryogenically-Cooled Loads for QUIET-II Detector

The Q/U Imaging Experiment (QUIET) is an experimental program to make very sensitive measurement of the Cosmic Microwave Background (CMB) polarization from the ground. The primary goal of QUIET is to detect the degree-scale B-modes induced by primordial gravitational waves, which is a “smoking gun” signature of inflation. Using an array with more than several hundreds of polarization detectors is essential to discover the faint B-modes signal. We are preparing for the second phase of QUIET with 500 detectors, following its first phase observation for establishing the techniques as well as searching for the B-modes in one of world best sensitivities.

For the precise measurement with such a large detector array, understanding the performance of the detectors “in the laboratory”, i.e. before starting the field observation, is essential. This requires an artificial polarization source, and we developed a novel calibration system with Cryogenically-Cooled blackbody absorbers. The advantages of this system over other conventional calibrators are (1) it can generate a well-characterized polarization signal under the similar radiation condition to the actual observation and (2) it allows us to calibrate both the total power and the polarization response simultaneously. These advantages make it possible to characterize the detectors in the laboratory.

We present the design and principle of the system, and demonstrate its use with the QUIET-I detector.

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