NOISE PERFORMANCE OF TES BOLOMETERS FOR FAR INFRARED ASTROMOMY

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The development of large format (> 1000 elements) cryogenic bolometer arrays is a requirement for future astronomical imaging and low resolution spectroscopy in the far-infrared and submillimeter. Recent research has led to a new approach to building arrays of many bolometers. Instead of a semiconducting thermistor, a superconducting transition edge sensor (TES) is used to read out the detector temperature. A TES bolometer has a faster response time than an identically-designed, same-sensitivity semiconducting bolometer (or a more sensitive bolometer for the same response time) due to the strong negative electrothermal feedback intrinsic in a voltage-biased TES. TES bolometers are inherently low impedance devices, so they are well matched to being read out by DC SQUID amplifiers. These amplifiers have a large noise margin over the TES Johnson noise and bolometer phonon noise. This permits the bolometer to be read out in a multiplexed fashion by a suitable SQUID multiplexer, potentially vastly reducing the amplifier size and the wire count. In light of these advantages, we have been developing the technologies for fabricating multiplexed superconducting TES bolometer arrays. Recently we have investigated the noise performance of Mo/Au-bilayer TES bolometers. These detectors use normal metal regions for the suppression of excess noise. These regions can be oriented either parallel to ("bars") or transverse to ("stripes") the direction of current flow. Detectors with stripes and/or with bars were fabricated at the NASA/GSFC detector development facility. The lowest noise detectors are found to have normal metal regions oriented transversely. We compare the noise measurement and quantitative analysis of the noise level in each device as a function of the detector parameters with focus on the properties of the most recently produced devices, which we have successfully used for astronomical observations in the submillimeter broadband spectrometer FIBRE at the Caltech Submillimeter Observatory.

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