Towards large FOV high-resolution X-ray imaging spectrometer: microwave multiplexed readout of 32 TES microcalorimeters

We performed a small-scale demonstration at GSFC of high-resolution x-ray TES microcalorimeter readout using a microwave SQUID multiplexer. This work is part of our effort to develop detector and readout technologies for future space-based x-ray instruments such as the microcalorimeter spectrometer envisaged for Lynx, a large mission concept under development for the NASA 2020 Decadal Survey. In this paper we describe our experiment, including details of a recently designed, microwave-optimized low-temperature setup that is thermally anchored to the 50 mK stage of our laboratory ADR. Using a ROACH2 FPGA at room temperature, we simultaneously read out 32 pixels of a GSFC-built detector array via a NIST-built multiplexer chip with Cu coplanar waveguide resonators coupled to Nb SQUIDs. The resonators are spaced 6 MHz apart (at ~5 K) and have quality factors of ~15,000. Using flux ramp modulation frequencies of 160 kHz we have achieved spectral resolutions of ~5.5 eV FWHM on each pixel at 6 K. We will present the measured system-level noise and maximum slew rates, and briefly describe the implications for future detector and readout designs.

Abstract

Microwave SQUID multiplexing

Response of the uMUX readout

Measured system noise and slew rate

Lynx

Promising initial results: microwave multiplexing of 5 TESs

Ongoing work: microwave multiplexing of 32 TES microcalorimeters

Microwave SQUID multiplexing

8 X 8 TES microcalorimeter, NASA/GSFC

Low temperature uMUX setup

Room temperature electronics

MnKa X-ray spectrum, R/Rn ~ 20 %

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