SIS Frequency Multiplexers and RF-to-DC converters for Frequency Division Multiplexed TES Read-out

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Frequency Division Multiplexing (FDM) is used for the read-out of large pixel number arrays of far-infrared and X-ray Transition Edge Sensors (TES). Within FDM a pixel within a TES array is AC biased with a unique MHz-frequency signal (with frequency spacing of order 10 KHz), where the frequency selection is achieved with high-Q superconducting filters. The resistance change of several bolometers, caused by the incoming radiation, is monitored simultaneously with a SQUID read-out. Because of the limited dynamic range of the SQUID, a limited amount of pixels (~100) can be read-out by a single SQUID. For large arrays of TES bolometers therefore many parallel channels of AC-biasing, SQUID feedback and SQUID read-out and biasing are necessary. The wiring harness that is necessary to run between 300 K and cryogenic temperatures is a limiting factor in the development of large pixel number arrays.

In order to reduce the wire count within the harness, we propose a novel use of SIS devices in the read-out of TES arrays. In this read-out scheme the SIS devices are used as GHz to MHz frequency up- and down converters. With frequency up- and down-conversion many parallel channels of a few MHz wide (where each channel would require separate wiring), can be stacked in series on carriers at GHz frequencies. These GHz signals can be sent over a single coaxial line. Furthermore we propose to use the SIS devices as RF-to-DC converters that can supply the DC-biasing and flux-offset to the SQUID. In the proposed scheme tens of thousands of TES pixels can be read-out over a single coaxial line.

We will present the read-out scheme, and discuss the feasibility and operating conditions of SIS devices as GHz-to-MHz frequency converters and RF-to-DC converter.