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FDM Readout of TES Bolometers for the SAFARI Far-Infrared Spectrometer

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SAFARI is the prime focal-plane instrument on board the space observatory, SPICA, a candidate for ESA's fifth medium class mission in its Cosmic Vision science programme, with a planned launch date in 2032. Combining a large, cold mirror with ultra-sensitive detectors (dark NEP $\leq 2 \times 10^{-19} \text{ W}/\sqrt{\text{Hz}}$), SPICA/SAFARI will probe the chemistry of the cold, dusty Universe with unprecedented sensitivity, allowing us to trace the evolution of galaxies out to high redshift, as well as the formation of stars and planets in our own Galaxy.

In order to read out SAFARI's ~3600 TES bolometers we use frequency domain multiplexing (FDM). Each TES is in series with a narrow band-pass filter and is voltage-biased by an AC tone tuned to the filter frequency. The resonance frequencies are defined by in-house developed cryogenic lithographic LC filters. Each readout channel comprises a set of ~160 TESs and LC filters and is read out with a SQUID preamplifier. The resulting output is a phase-shifted copy of the applied AC bias tones, amplitude-modulated by each corresponding TES. Baseband feedback is applied to overcome the dynamic range limitations of the SQUID.

We have carried out extensive characterization of the FDM readout system coupled to a 176-pixel TES bolometer array in order to understand the performance, calibration, and crosstalk of the system. Based on these results, we have established the design parameters for the LC filter-chips and TES bolometer arrays fabricated for the next generation of the FDM readout demonstrator. We present our latest results and discuss them in the context of the instrument performance.

Less than 5 years of experience since completion of Ph.D

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Student (Ph.D., M.Sc. or B.Sc.)

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