Contribution ID: **143** Type: **Oral Presentation**

Highly-multiplexed microwave SQUID readout using the SLAC Microresonator Radio Frequency (SMuRF) Electronics for Future CMB and Sub-millimeter Surveys

Monday, 10 December 2018 11:30 (30 minutes)

The readout of large arrays (exceeding 10,000 sensors) of superconducting sensors stands to benefit substantially from improvements in cold and warm readout technologies and techniques. In order to reduce the readout cost per sensor and integration complexity, many efforts are focused on achieving higher multiplexing factors using techniques that densely channelize superconducting sensors by coupling them to high-Q superconducting resonators or use superconducting resonators themselves as sensing elements. Highly-multiplexed cold readout technologies in active development which utilize superconducting resonators include Microwave Kinetic Inductance Sensors (MKIDs) and microwave rf-SQUIDs (uMUX). Both technologies hold the promise of enabling the read out of tens of thousands or even possibly hundreds of thousands of superconducting sensors in the bandwidth of a single microwave transmission line. In the case of microwave SQUID multiplexing, arrays of transition-edge sensors (TES) are multiplexed by coupling each TES to its own superconducting microwave resonator through an rf-SQUID. We have developed a new warm readout system for microwave SQUID multiplexing, the SLAC Superconducting Microresonator RF electronics (SMuRF), which is built upon the SLAC National Lab's Reconfigurable Cluster Element (RCE) Common FPGA Platform. SMuRF will read out more than 4000 microwave SQUID channels between 4 and 8 GHz per RF line. The system simultaneously reads out changes in flux in each resonator-coupled rf-SQUID by monitoring the change in the transmitted amplitude and frequency of RF tones produced at each resonator's fundamental frequency. The SMuRF system is unique in its ability to track each individual resonator's resonance frequency as its rf-SQUID is flux-ramp modulated, minimizing the total RF power required to read out each resonator and significantly reducing the linearity requirements on the cold and warm readout. SMuRF is being explored as a potential readout solution for several future CMB projects including Simons Observatory, BICEP Array, AliCPT, CCAT-prime, and CMB-S4. In addition, parallel development of the platform is underway to adapt SMuRF to read out MKID and X-ray microcalorimeter arrays.

Primary author: Dr HENDERSON, Shawn (SLAC National Accelerator Laboratory)

Presenter: Dr HENDERSON, Shawn (SLAC National Accelerator Laboratory)

Session Classification: Parallel Session: Superconducting Detectors

Track Classification: Superconducting Detectors