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Universal microwave multiplexing modules: the Simons Observatory cryogenic readout system with a 1764 multiplexing factor

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Universal microwave multiplexing modules (UMMs) contain the 100 mK components of the Simons Observatory (SO) microwave multiplexing readout system. SO will map the cosmic microwave background in 6 frequency bands centered between 27 and 270 GHz with 60,000 transition edge sensor (TES) bolometers housed in 49 focal plane arrays called universal focal plane modules (UFMs). Enabling this high detector count is the SO readout system, which aims to multiplex up to 1764 detectors with a single coaxial line pair. The UMM is a compact, low-profile assembly that will be integrated directly behind the detector array in the UFM. The design allows the UFMs to be tightly packed in a tiled hexagonal configuration, maximizing the amount of focal plane area occupied by detectors. The UMM contains two 150 mm wafers, termed the “DC” and “RF” wafers, as well as 28 multiplexer chips. The DC wafer contains the TES bias resistors and Nyquist inductors and the RF wafer connects the multiplexer chips in series. The multiplexer chips, each with 65 microwave SQUID readout channels and resonators between 4-8 GHz, are mounted on the DC wafer. We detail the packaging design of the UMM and present measurements of microwave transmission, resonator statistics (including yield, frequency spacing, bandwidth, and frequency modulation), and input-current-referred noise. We comment on the status of implementing this readout assembly architecture for the Simons Observatory.

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

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