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Developing AlMn films for Argonne TES fabrication

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The reference design for the next-generation cosmic microwave background (CMB) experiment, CMB-S4, relies on large arrays of transition edge sensor (TES) bolometers coupled to Superconducting Quantum Interference Device (SQUID)-based readout systems. Mapping the CMB to near cosmic variance limits will enable the search for signatures of inflation and constrain dark energy and neutrino physics. AlMn TESes provide simple film manufacturing and highly uniform arrays over large areas to meet the requirements of the CMB-S4 experiment. TES parameters such as critical temperature and normal resistance must be tuned to experiment specifications and can be varied based on geometry and steps in the fabrication process such as deposition layering, geometry, and baking time and temperature. Using four-terminal sensing, we measured Tc and Rn of AlMn 2000 ppm films and devices of varying thicknesses fabricated at Argonne National Laboratory to motivate device geometries and fabrication processes to tune Tc to 150-200 mK and Rn to ~10 mOhms. Measurements of IV curves and time constants for the resulting devices of varying leg length were made using time-division SQUID multiplexing, and determined Tc, G, k, f_3db, and Rn. We present the results of these tests along with the geometries and fabrication steps used to tune the device parameters to the desired limits.

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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