5th Workshop on the Physics and Applications of Superconducting Microresonators

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Polarization-sensitive MKID arrays fabricated from TiN/Ti multilayers

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In recent years, NIST has started a program to develop microwave kinetic inductance detectors (MKIDs) for polarimetric imaging applications over a broad range of observation frequencies (~90 GHz to 1.4 THz). In this talk, we overview the current status of feedhorn-coupled and dual-polarization sensitive MKIDs fabricated from Ti/TiN multilayer films. We describe extensive materials development, which has enabled uniform, Tc-tunable arrays on 100mm diameter substrates. We detail the lumped-element, dual-polarization sensitive pixel design and present measurements that demonstrate photon-noise limited sensitivity for thermal loads > 0.5 pW and polarization sensitivity with <2% cross-polarization at 250 micron. We discuss several aspects of low frequency device stability, including the dependence on LC resonator geometry and under different optical loading conditions. The impact in both the frequency and dissipation quadrature will be presented.

Arrays of this architecture have been fabricated for the balloon-borne polarimeter BLAST-TNG. One challenge of this implementation is how to achieve the required, high multiplexed density when operating the devices from a 300 mK bath temperature, where one must be concerned with degraded quality factors from thermal quasiparticles. We present the 250 micron array design, which overcomes this challenge and contains 918 spatial pixels (1836 resonators) within a 100 mm diameter footprint and uses three microwave feedlines for readout. We also show initial measurement results, including photon-noise sensitivity, achieved coupling and total quality factors, and frequency collision rate. Lastly, we discuss how this design scales to other wavebands for other applications such as precision measurements of the polarization of the cosmic microwave background.

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