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Titanium nitride lumped element kinetic inductance detector with parallel plate capacitances

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Kinetic inductance detectors (KIDs) are an attractive sensor option for large-format arrays because they are highly multiplexable. Microstripline-coupled architectures are particularly attractive because they provide flexibility in optical coupling (phased-array antennas, lens-coupled antennas, and feedhorns) and permit integration of on-chip bandpass filters. However, there has not been demonstrated to date a microstrip-coupled KID architecture also capable of background-limited performance under the most demanding conditions, for observations of the CMB and SZ effect at 100 and 150 GHz. More generally, an architecture capable of covering both signal and foreground/background bands for these applications, from 30 GHz to 420 GHz, is desirable. To this end, we are developing microstrip-coupled titanium nitride (TiNx) KIDs in a coupling architecture amenable to this wide frequency range. TiNx's high normal-state resistivity ensures that two-level-system and readout noise can be made subdominant to photon and recombination noise, and the variation of Tc with stoichiometry will enable operation down to 30 GHz and lower. However, to avoid having an impedance mismatch between the low impedance microstrip exiting reception architectures and the high resistivity TiNx, we have designed a mm-wave coupler that capacitively couples the microstrip with the TiNx inductor. Finally, parallel plate capacitances have been used for this novel KID design in order to mitigate direct absorption of the incoming light that was previously observed with interdigitated capacitances.
We have fabricated two versions of this TiNx lumped-element KID design, using two different dielectrics: hydrogenated amorphous silicon (a-Si:H), and the crystalline silicon (c-Si) layer of a SOI (Silicon on insulator) wafer. We present here the first dark measurements (detectors unilluminated) and cryogenic blackbody measurements for these two different prototypes.

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

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