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Advanced Feedhorn Coupled MKIDs

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After more than 15 years of development, the technical maturity of MKIDs has greatly improved. Array level demonstrations of imagers and spectrometers now exist, measuring a wide coverage of frequencies, and with multiple optical coupling schemes. However, several different technical challenges must be overcome before MKIDs reach the point where they become a general solution for the full suite of astronomical and instrumental applications. First, MKIDs have not consistently shown background limited sensitivity, especially at the low frequencies (< 1 Hz) essential to bolometric observations. Also, modern bolometric cameras require use of advanced focal planes in which the detectors are comprised of integrated circuits performing multiple functions such as optical coupling, diplexing, and on-chip filtering of multiple frequency bands within 1 spatial pixel.
Our efforts at NIST have been to both extend the successful direct-absorber style polarimeters pioneered for use in the balloon-borne instrument BLAST and in production for TolTEC, as well as integrate MKIDs into the proven mm-wave circuitry of NIST's well-established OMT-coupled TES bolometer arrays that have been delivered to many collaborations. We have extended the direct-absorbing MKID technology to longer wavelengths and lower photon loadings by creating hybrid MKIDs combining the low capacitive loss of the TiN-Si interface with the high sensitivity and lower sheet resistance of thin Al inductors. We also prevent the well-known aging of the Al through the deposition of a thin passivation layer without compromising their performance. These sensors show photon limited performance well below 1 Hz. Furthermore, we have also integrated Al-based inductors and amorphous-Si based parallel-plate capacitors into an OMT-coupled circuit and have initial results of photon-noise limited performance.

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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