Poster

Optical Measurements of SuperSpec: A Sub-millimeter-wave On-chip Spectrometer

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SuperSpec is a novel on-chip spectrometer we are developing for sub/millimeter wavelength astronomy. Our approach utilizes a filterbank of moderate resolution (R~ 500) channelizers, coupled to lumped element Kinetic Inductance Detectors (KIDs), all integrated onto a single silicon chip. The channelizers are half wave resonators formed by lithographically depositing segments of superconducting transmission line, and the KIDs are titanium nitride (TiN) resonators. The compact nature of this design, combined with the simplicity of the frequency domain KID readout, will facilitate large format multi-object spectroscopy. We have fabricated a first generation chip containing 77 channels spanning the 195-310 GHz band, and we will present optical and dark measurements characterizing this device. Free-space radiation is coupled into a microstrip transmission line on the chip by means of a wide-band multiple flare angle horn, terminated by a custom designed waveguide probe. We have used frequency sweeps with a coherent optical source to measure resonant frequencies and spectral profiles of the millimeter-wave channelizers. The chip contains channels with quality factors Q~300-900, which are consistent with electromagnetic simulations of these channels, and provide an estimate of dissipative loss in the resonators. The absolute response is lower than expected given previous measurements of TiN absorbers, and we will discuss our on-going efforts to understand the origins of the low response. We measure a fractional frequency noise of $S_{ffr} \leq 5 \times 10^{-17}$ Hz^{-1}, consistent with arising from two-level system noise in the resonator capacitor.