

Contributed Talk

Design and Performance of SuperSpec: An On-chip, KID-based, mm-wavelength Spectrometer

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SuperSpec is an ultra-compact spectrometer-on-a-chip for mm and submm wavelength astronomy. Its very small size, wide spectral bandwidth, and highly multiplexed detector readout will enable construction of powerful multi-object spectrometers for high-redshift observations. SuperSpec employs a filter bank consisting of planar, lithographed superconducting transmission line resonators. Each mm-wave resonator is coupled to both the feedline and to the inductive portion of a lumped element Kinetic Inductance Detector (KID). The design is realized using thin film lithographic structures on a Si wafer, with titanium nitride KID resonators. We will discuss the design and optimization of the KID detectors and mm-wave filter bank circuit, and the performance of a laboratory test device. This 77-channel filter bank prototype employs a custom wide-band metal feed horn and operates in the 195-310 GHz band. This prototype has demonstrated optical filter bank channels with a range of resolving powers from $R \sim 300$ to $R \sim 900$, measured noise performance of $S_{\text{flr}} \leq 5 \times 10^{-17} \text{ Hz}^{-1}$, and low out-of-band response. We will discuss the design of a second-generation optimized device, and the ongoing development of a demonstration instrument consisting of two spectrometers, one operating in the 1-mm atmospheric window and the other covering the 650 and 850 micron bands.