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Progress on SuperSpec Filterbank Improvements for Future Far-IR Spectroscopic Astronomical Measurements

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SuperSpec is an ultra-sensitive on-chip spectrometer for mm and sub-mm wave observations of high-redshift dusty galaxies. The device employs a filterbank architecture in which kinetic inductance detectors (KIDs) are coupled to mm-wave resonant filters along a single microwave feedline. We present the progress on several advances to the SuperSpec filter bank technology that will be crucial for future far-IR missions. In particular, we present the characterization of a prototype filterbank utilizing thin film aluminum (Al) KIDs for higher sensitivity compared to previous titanium nitride (TiN) devices. In addition, in order to target higher resolving power ($R \sim 3000$), we must reduce filterbank dielectric losses ($Q_{loss} \sim 2 \times 10^4$). We will pursue two technologies using a silicon (Si) inner layer dielectric over the current silicon nitride (SiN). First, amorphous silicon (a-Si) offers simple fabrication and low loss at low power. Second, crystalline silicon (c-Si) presents a more challenging fabrication process, including a "flipped-SOI" process using silicon-on-oxide wafers, but has been shown to have $\tan\delta$ as low as 5×10^{-6}. Finally, in order to push the SuperSpec filterbank technology frequencies up to 1.3 THz, we require a higher T_c film replacement for our niobium (Nb) microstrip. For this purpose, we offer preliminary data on niobium titanium nitride (NbTiN) and niobium nitride (NbN) films.

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

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