Development of a 350-GHz Dual-Polarization On-Chip Spectrometer

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Spectral imaging observations provide information on the composition and physical conditions of observed astronomical sources as well as their redshifts. Broadband imaging spectrometers are therefore playing an increasingly important role in terahertz astronomy. While different spectrometer techniques (e.g., FTS and grating) have been explored, on-chip integrated superconducting spectrometers such as SuperSpec [1] and DESHIMA [2], which are much more compact, are emerging as powerful imaging spectrometers in the THz regime (loosely defined as 0.1-10 THz). Such an imaging spectrometer is based on a superconducting filter bank of low loss and high selectivity that splits a broadband signal into different frequency channels with a typical frequency resolution of 100-1000. Note that the broadband signal is firstly received by a broadband planar antenna and then transmitted to the superconducting filter bank. Each filter in the filter bank is followed by a microwave kinetic inductance detector for power detection. Obviously the detection sensitivity is defined by both the MKIDs and the filters. Furthermore, imaging is achieved by simply adding more pixels in a single chip, with each pixel providing an independent spectrum.

Imaging spectrometers of this kind are still in their infancy, but they have received widespread attention. In this paper, we introduce a 350-GHz on-chip integrated superconducting spectrometer, which is developed for technical demonstration on the POST submillimeter telescope [3]. Based on aluminum (Al) MKIDs incorporating a Nb/SiO_2/Nb microstrip-line filter bank, we are developing a 350-GHz on-chip integrated superconducting spectrometer with a frequency resolution of over 200. Detailed filter simulation and dark noise measurement results are presented.

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