PHOTON-COUNTING SUPERCONDUCTING DETECTORS FOR SUBMILLIMETER ASTRONOMY: RECENT RESULTS

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We are developing superconducting direct detectors for submillimeter astronomy that can detect individual photons. These Al-based STJ detectors count quasiparticles generated breaking Cooper-pairs by photon absorption in the submillimeter band. They could yield high quantum efficiency, microsecond response time, and sensitivities of 1e-20 W/rt(Hz). The use of antenna coupling to a small absorber also suggests the potential for novel instrument designs and scalability to imaging or spectroscopic arrays. The use of an RF readout scheme also naturally lends itself to wavelength-division multiplexing for simultaneous readout of large arrays. We describe device concept, fabrication and dark current characterization of these detectors. Measurements of the STJ dark current scale exponentially with temperature down to 200 mK and can be as small as 1 fA, corresponding to detector sensitivity less than 1e-20 W/rt(Hz). We are also developing hot-electron microbolometers that can be used as calibrated blackbody sources for characterizing the detector photoresponse. We will also present current work on RF readout, noise and sensitivity characterization. All of these developments will be key ingredients in scaling to large detector arrays.