Abstract

Far-infrared Photon-Counting Detectors
Rob Schoelkopf
Yale University Dept. of Applied Physics and Physics

I will attempt to review the state of the art and future prospects for very high sensitivity direct detectors in the wavelength range from a few millimeters to 100 microns. Though excellent heterodyne detectors for this portion of the spectrum are available, and can approach the fundamental limit of 1/2 photon per mode of added noise, a high-performance direct detector can still be superior in low-background applications. The simplicity and scalability for producing arrays of direct detectors may also be favorable in comparison with heterodyne systems. There are several types of cryogenic detectors currently in development which have promise to produce sensitivity levels many orders of magnitude better than the present noise-equivalent powers of ~10^-17- 10^-18 Watts/rt(Hz). These new devices include antenna-coupled bolometers using NIS (normal-insulator-superconductor) junctions and transition-edge sensor (TES) bolometers, as well as cryogenic photoconductors based on superconductors (SQPC) or semiconductor quantum dots. The photoconducting detectors in particular may be capable of true single-photon counting in the submillimeter band, as recently demonstrated by Komiyama et al. I will focus on the prospects and challenges for these devices, and on recent progress at Yale & NASA/GSFC on detector readouts using single-electron transistors (SETs).