MEASUREMENT AND EVALUATION OF SOME CANDIDATE SUPERCONDUCTING DETECTOR TECHNOLOGIES FOR ASTRONOMICAL IMAGING AND SPECTROSCOPY

Day P.K.[1], Leduc H.G.[1], Mazin B.A.[2] , Zmuidzinas J.[2]
[1]Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena, CA
[2]California Institute of Technology, 1200 E. California Blvd., Pasadena CA

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Several types of superconducting detectors are presently being considered for application in astronomical instruments. The microwave kinetic inductance detector (MKID) is a relatively new detector technology that provides a possible path to the large arrays that are needed for cameras, because of a straightforward approach to array readout. These detectors are based on planar high Q superconducting resonators which allows for multiplexing in the frequency domain at microwave frequencies. Measurements have been made which identify the limiting noise source of the MKID and which elucidate the sensitivity degradation under input power loading. Progress has been made toward reducing the noise of these detectors to the photon noise limit. Transition edge sensor bolometers, isolated with suspended silicon nitride structures, have demonstrated adequate sensitivity for background limited imaging at millimeter through FIR wavelengths and are compatible with SQUID multiplexing techniques. For space-borne medium resolution spectroscopy where the photon background is greatly reduced, NEP on the order of $2 \times 10^{-20} W/Hz^{1/2}$ is needed. To achieve that sensitivity, the thermal conductance of the supporting silicon nitride beams must be decreased by a factor of 100 - 1000 as compared with the current state-of-the-art devices. The description energy transport through such structures is falls well within the quantum regime, with only the lowest few vibrational modes contributing to the conductance. Measurements demonstrating the crossover to quasi-1D thermal transport in silicon nitride beams will be presented. Antenna coupled hot electron bolometers are an alternative technology for both imaging and spectroscopy in the submillimeter and FIR. New data on the achievable electron-phonon thermal conductance and possible detector designs will be discussed.

1. (a)
   Peter Day
   Jet Propulsion Laboratory
   4800 Oak Grove Dr.
   MS 302-306
   Pasadena, CA
   91109 USA
   Peter.K.Day@jpl.nasa.gov

   (b) 818-354-9356

   (c) 818-393-4540

2. J - Radio Astronomy

3. (a)

4. I - Invited Paper

5. No special instructions