Antenna-Coupled Superconducting Hot-Electron Detectors

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We develop a hot-electron transition-edge sensor for low-background submillimeter wave astronomy. The sensor is made from a thin (20 nm) Ti film placed between Nb Andreev contacts, which prevent the diffusion of hot-electrons. The intrinsic electron-phonon thermal conductance determines the noise equivalent power (NEP) ~ 10^{-18} W/Hz^0.5 at 0.3 K for micron size devices. Currently, we are fabricating detector devices of the size down to 1x1 um^2 integrated with a 600 GHz twin-slot antennas on bulk Si substrate. A detector chip is placed on the back of a focusing elliptical Si lens with parylene anti-reflection coating. We anticipate that the devices with the size down to 0.5x0.1 um^2 will be possible in near future that would bring the intrinsic NEP close to 10^{19} W/Hz^0.5. A test system for direct measurements of the optical NEP has been built. The system features a cryogenic black body source built in the dilution refrigerator and a low-noise read-out SQUID amplifier. The test system is enclosed into a 1.5 K radiation shield. In order to eliminate any potential heating of the detector by radiation from warmer parts of the cryostat, the detector assembly is additionally shielded at 0.3 K. During the meeting, we will report the results of the NEP and of the output noise measurements in comparison with the theoretical modeling.