Performance of Superconducting Hot Electron Bolometers at Terahertz Waveband

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Low noise receivers based on superconducting niobium nitride (NbN) hot electron bolometers (HEBs) have been designed, fabricated and measured for applications in astronomy and cosmology at terahertz (THz) waveband.[1][2] The NbN HEB consists of a planar antenna and an NbN bridge connecting across the antenna's inner terminals on high-resistivity Si substrates. Double sideband (DSB) receiver noise temperatures of 698 K at 0.65 THz, 904 K at 1.6 THz, 1026 K at 2.5 THz and 1386 K at 3.1 THz have been obtained at 4.2 K without corrections. It is about 9 times of the quantum limit noise temperature at 2.5 THz and same with the performance of the HEB used in the Herschel Satellite. The excess quantum noise factor of about 4 has been estimated using a quantum noise model. Also, the stability of the HEB has been characterized using the Allan variance measurements. Allan time (T_A) of about 1 s has been obtained using a Gunn oscillator plus its multipliers as the LO source, and the stability of the HEB receiver is dependent on that of the LO. Using microwave injection with a feedback loop, the stability of the receiver is improved; and a T_A value of about 20 s is obtained.

[1]1 J. Chen, Y. Jiang, et al., IEEE Trans. on Appl. Supercond., (2011), in press.
[2]2 M. Liang, J. Chen, et al., IEICE Trans. Electron., E93-C, 473 (2010).

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