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Highly sensitive NbN hot electron bolometer mixer at 5.25 THz

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***Abstract*—We report noise measurements of a NbN hot electron bolometer (HEB) heterodyne receiver at super-THz frequencies and demonstrate a DSB receiver noise temperature (T_{rec}) of 1140 K at 5.25 THz, which is directly measured (no any corrections) and is 4.5×hν/k. The measured T_{rec} versus current for the optimal voltage is given in figure 1 and a 2D receiver noise temperature plot in figure 2.**

Our experiment is motivated by: a) demonstration of a sensitive HEB mixer for the observation of the fine-structure line of neutral atomic oxygen (OI) at 4.7 THz; b) establishing experimentally the ultimate sensitivity of an NbN HEB mixer at the high-end of THz frequency range.

The HEB mixer used consists of a 0.2 □m-long and 2 □m-wide NbN bolometer [1] and a tight winding spiral antenna with an inner diameter of 6.6 □m. Based on the HFSS simulation for the antenna, a high radiation power coupling efficiency between antenna and HEB up to 6 THz is expected.

The measurement setup is similar to the one in ref. [2] (all built in vacuum). In details, the optics between hot/cold load and the HEB consists of a Si lens coated with Parylene C designed for 4.25 THz, a QMC metal-mesh low-pass filter, and 3 μm thick beam splitter. As local oscillator, we use an optically pumped FIR ring gas laser.

[1] The NbN film on Si is standard, produced at Moscow State Pedagogical University, Moscow, Russia.
[2] P. Khosropanah, J.R. Gao, W.M. Laauwen, M. Hajenius and T.M. Klapwijk, "Low noise NbN hot-electron bolometer mixer at 4.3 THz," *Appl. Phys. Lett.*, **91**, 221111 (2007).