

A Photonic Local Oscillator for an SIS Mixer in the 100 GHz Band

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We have developed a waveguide-mounted photomixer in the 75-115 GHz band with a uni-traveling carrier photodiode (UTC-PD) [1-3] which is optically pumped by two 1.55- μm lasers. We have successfully demonstrated to produce an output power of ~ 2 mW at 100 GHz with an input laser power of ~ 100 mW.

An SIS (Superconductor-Insulator-Superconductor) mixer has been pumped by the photomixer as a local oscillator (LO). The photomixer output and an RF signal are quasi-optically combined by a mylar film with a coupling efficiency of a few percent in front of the dewar and then coupled into the SIS mixer. This LO coupling scheme is the same as those used in low-noise receivers at millimeter wavelengths. We have found that in this configuration the photomixer can provide a sufficient LO power required for optimum operation of the SIS mixer in the frequency band from 93 to 120 GHz. The minimum receiver noise temperature (DSB) of the SIS mixer was 26 K which is as low as those reported to date in the same frequency range. We have carried out similar experiment using a Gunn-diode LO source and carefully compared the receiver noise temperature of the SIS mixer with photomixer pumping case. No significant difference of receiver noise temperatures between the two cases was found. This result indicates that the photomixer can be quite adequate for supplying the LO to SIS mixers in the 100 GHz band.

Encouraged by good performance of the photomixer in the 100 GHz band, we are going to fabricate a photomixer in the 270-370 GHz band. The design of the photomixer has been completed and is under fabrication. Preliminary results on the RF generation experiment of the 270-370 GHz-band photomixer will be included in the presentation.

[1] H. Ito *et al.*, *Electron. Lett.*, **35**, pp.1556–1557, 1999.

[2] T. Ishibashi *et al.*, *Proc. IEEE 7th Int. Conference on Terahertz Electron.*, pp. 36–39,
Nara, Japan, Nov. 1999.

[3] T. Noguchi *et al.*, ALMA memo #399, <http://www.alma.nrao.edu/memos/> .

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