

SIS receiver for the 1.2 THz frequency using NbTiN/AlN/Nb junctions

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Abstract

We present the development of SIS mixer for the band 1.1-1.25 THz of the FIRST heterodyne receiver. The choice of the SIS mixer for the THz frequency receiver is motivated by a relatively low output mixer noise of 20-30 K and by a low intrinsic conversion loss of about 3-5 dB at the frequency of interest. This allows one to consider a possibility to build an SIS receiver with equivalent DSB receiver noise temperature close to 2-3 $h\nu/k$ in the 1-1.3 THz band.

The SIS mixer is using a quasi-optical design with Si hyper hemispherical lens and with a planar twin slot antenna. The two NbN/AlN/Nb $0.7 \mu\text{m}^2$ area junctions are used in the mixer. The Josephson critical current is close to 45 kA/cm^2 and in the middle of the band $R\omega C \approx 5$.

The ground plane of the mixer circuit is made of NbTiN. The critical temperature of the NbTiN film deposited at the Si substrate is close to 16 K. The tuning circuit of the junctions is made of a normal metal.

The expected loss in the junction tuning circuit is about 1 dB and the overall receiver conversion loss is expected to be close to 7 dB. The mixer testing is under way.