Investigation of Tunnel Superconducting Junction Mixing Regimes.

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Mixing superconducting structures based on tunnel junctions are widely used in THz receiving systems. In such systems Josephson effect is conventionally known as parasitic, causing the additional noise. That is the reason why critical current of the junctions is usually suppressed by external magnetic field. In the present work it is shown that there are some applications where Josephson regime of work is preferable.

During this work we investigated different working regimes of tunnel junction superconductor-insulator-superconductor (SIS) based on three-layer Nb/AlOx/Nb and Nb/AlOx/Nb structures as mixers (in the frequency range 0.1-20 GHz) and harmonic mixers (for the frequencies about 600 GHz and 20 GHz). The quasiparticle and Josephson mixing regimes have been studied, the numerical modelling of these regimes has been made. The influence of SIS-junction parameters on mixing capability of SIS-junction was examined. We demonstrated, that in some applications, such as cryogenic harmonic phase detector, based on SIS-junction, Josephson regime can be more preferable than quasiparticle because it allows to realize larger output signal (12 dB more) and larger signal-to-noise ratio (4 dB more) compared to quasiparticle regime. Also the prospects of Josephson mixing regime for cryogenic multiplexing systems are demonstrated.