

## The operation of SIS mixer as up- and down-converter at low frequencies for frequency multiplexing

Anton A. Artanov<sup>1,2,\*</sup>, Konstantin V. Kalashnikov<sup>1,2</sup>, Gert de Lange<sup>3</sup>, Valery P. Koshelets<sup>1</sup>

<sup>1</sup> *The Kotelnikov Institute of Radio Engineering and Electronics, Russian Academy of Science,  
11/7 Mokhovaya St., 125009, Moscow*

<sup>2</sup> *Moscow Institute of Physics and Technology,  
Institutskii per., 9, 141700 Dolgoprudny, Moscow Region, Russia*

<sup>3</sup> *SRON Netherlands Institute for Space Research, P.O. Box 800,  
9700 AV Groningen, the Netherlands*

*\*Email: artanov@hitech.cplire.ru*

A feasibility study of a frequency multiplexed read-out scheme for large number Transition Edge Sensor arrays is described in paper [1]. The read-out makes use of frequency up- and down-conversion with Superconducting-Insulator-Superconducting (SIS) tunnel junctions operating at GHz frequencies, in combination with an existing frequency multiplexed read-out at MHz frequencies. Such read-out scheme can drastically reduce the wiring from room temperature to the cryogenic detectors.

Experimental measurements of a SIS tunnel junction operating as frequency up- and down-convertors at low frequencies (< 10 GHz) were carried out. A possibility to implement a "traditional" SIS-mixer for down- and up-conversion with acceptable conversion loss (well below 15 dB) has been demonstrated. Dependencies of the conversion efficiency on the SIS-junction parameters, local oscillator (LO) power and SIS-bias have been measured and compared with theoretical estimations. The best conditions for the SIS-mixer operation at low LO frequencies have been determined. The transitions between different regimes of operations (quantum and classical; quasiparticle and Josephson) have been studied in a wide bath temperature range by using specially designed circuits with an integrated control line for the Josephson effect suppression. Preliminary conclusions on the feasibility of the frequency-multiplexed TES read-out using superconducting tunnel junctions will be presented.

The work was supported by The RFBR and the Ministry of Education and Science of the Russian Federation.

### References

1. G. de Lange «Feasibility of a frequency-multiplexed TES read-out using superconducting tunnel junctions», Journal of Low Temperature Physics, special issue LTD 15.