Contribution ID: **50** Type: **Poster**

Observation of Frequency Up-conversion Gain in SIS Junctions at Millimeter Wavelengths

Thursday, 25 July 2019 18:45 (15 minutes)

We report on the observation of frequency up-conversion gain in superconductor-insulator-superconductor (SIS) tunnel junctions at millimeter wavelengths. So far, SIS tunnel junctions have been used as frequency down-converters with the ultra-low noise performance approaching the quantum limit and have exhibited positive gain in the down-conversion process. In principle, it is also possible to operate SIS tunnel junctions as frequency up-converters with ultra-low noise and positive gain. Our proposal is to use SIS junctions as a frequency up-converter in a novel microwave amplifier in combination with an SIS down-converter. Given that both SIS mixers (up- and down-converters) pumped by an local oscillator signal have positive conversion gains and were connected in cascade, input and output frequencies are identical with a signal gain, which has been demonstrated by our proof-of-concept test module [AIP Advances, vol. 8, no. 2, Art. no. 025206 (2018)]. For detailed analysis to improve the performance, it is important to investigate characteristics of the SIS up-converter itself. So, we have developed a test setup to measure frequency up-conversion gain in SIS tunnel junctions at millimeter wavelengths. A conventional SIS mixer with Nb/AlOx/Nb tunnel junctions was used as a frequency up-converter, which has a 20-dB input attenuator and a stainless steel WR-10 output waveguide in a 4-K cryostat. An up-converted signal from the cryostat is measured by a room temperature down-converter system with the double sideband (DSB) noise temperature of about 800 K calibrated for hot and cold loads. We observed distinct intermediate frequency responses to signal inputs from a microwave noise source (with a typical excess noise ratio of 21 dB) biased on and off, which indicated that DSB up-conversion gain in SIS junctions to be positive. Results with a continuous wave source will also be reported.

Less than 5 years of experience since completion of Ph.D

Y

Student (Ph.D., M.Sc. or B.Sc.)

Y

Primary authors: Mr KOZUKI, Yuto (The University of Elector-communications); Prof. KOJIMA, Takafumi (National Astronomical Observatory of Japan); Prof. SHAN, Wenlei (National Astronomical Observatory of Japan); Prof. UZAWA, Yoshinori (National Astronomical Observatory of Japan)

Presenter: Mr KOZUKI, Yuto (The University of Elector-communications)

Session Classification: Poster session

Track Classification: Detector readout, signal processing, and related technologies