



Contribution ID: 105

Type: **Poster**

## On-wafer Characterization of Frequency Conversion Properties in an SIS Tunnel Junction

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

We present an investigation of frequency up- and down-conversion processes in a superconductor–insulator–superconductor (SIS) tunnel junction. A quasiparticle SIS tunnel junction potentially allows positive conversion gain in the down-conversion process from a millimeter wave to a microwave. Recently, we experimentally found that the tunnel junction can also up-convert a microwave signal to a millimeter-wave signal with positive conversion gain. Based on the bilateral gain in the SIS up- and down-conversion processes, we proposed a novel microwave low-noise amplifier and demonstrated the proof of concept. The amplifier uses SIS up- and down-converters which were connected in cascade and driven by a local oscillator (LO) power.

In order to design the amplifier with low noise and high gain, it is important to accurately evaluate and characterize both the SIS converters at radio frequency (RF) and intermediate frequency (IF). However, in general, the evaluation of cryogenic devices at millimeter-wave and even microwave frequencies has been carried out based on a module approach. In this case, the measured conversion gain and impedance are affected by interconnections and interfaces of the package, e.g. connectors, bonding wires and transmission line. This requires correction of the measured values to extract device parameters, which makes uncertainties.

We have evaluated SIS tunnel junctions to estimate specific capacitance using a 4-K cryogenic probe station, which allows us to directly measure S-parameters. In this study, we extend the on-wafer measurement system to directly evaluate SIS up- and down-converters by injecting an LO power at around 40 GHz and adding low and high pass filters to separate the RF and IF signals.

In the conference, the characterization method and the properties of the SIS converters will be presented.

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

N

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

N

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

**Presenter:** Dr KOJIMA, Takafumi (National Astronomical Observatory of Japan)

**Session Classification:** Poster session

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