# DESIGN AND ANALYSIS OF A WAVEGUIDE NBN-BASED SIS MIXER USING TWO HALF-WAVELENGTH-DISTRIBUTED JUNCTION TUNING CIRCUIT FOR ALMA BAND 10

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**Abstract** Submillimeter-wave SIS mixers with quantum limited noise sensitivity and wideband characteristics are needed in radio-astronomy projects such as the Atacama Large Millimeter Array (ALMA), the Far-Infrared Space Telescope (FIRST), and so on. So far, we have demonstrated low-noise performance and broadband operation in the 900 GHz band by a quasi-optical NbN-based SIS mixer employing self-compensated distributed tunnel junction with a high current density of 45 kA/cm$^2$. In order to use such SIS mixers for practical applications, reliability and further low noise characteristics are necessary.

We are currently developing waveguide SIS mixers based on NbN with aim of applying for the ALMA band 10 (780-950 GHz). The waveguide mixer mount employing an MgO substrate was designed by HFSS. The mixer used a waveguide-to-microstip transition, which is similar to the design of Nobeyama Radio Observatory of Japan. The simulation by HFSS showed the source impedance of around 60 $\Omega$ in the band by using the MgO substrate with the thickness of about 30 $\mu$m. A tuning circuit was proposed to reduce the current density of the NbN SIS junctions without spoiling broadband operation, which consists of two distributed SIS junctions with half-wavelength connected with a half-wavelength microstripline, just like a filter structure. Simulated mixer performance based on an experimental I-V curve of NbN SIS junction showed SSB mixer noise temperatures of below 130 K from 750 to 980 GHz assuming the junction current density of 25 kA/cm$^2$.

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