A 1.5 THz waveguide HEB mixer using silicon-on-insulator substrates for the Stratospheric Terahertz Observatory

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Abstract

The Stratospheric Terahertz Observatory (STO) is a long-duration balloon-borne telescope that will initially map the Galaxy in two key spectroscopic lines, C+ at 1.9 THz and N+ at 1.46 THz [1], using two arrays of superconducting hot-electron bolometer receivers. We are currently fabricating the lower frequency mixers for this project, and 4 units will be built and assembled to form an array. The basic mixer design is similar to the one developed for the receiver operating in Chile [2], with one key difference: instead of using quartz for the mixer substrate material, we use silicon-on-insulator (SOI) wafers, with which it is possible to obtain final chip thickness of only a microns. The use of very thin silicon permits us to easily scale the mixer design to higher frequencies, and at the same time to take advantage of the fact that superconducting nitride films for mixer applications grow best on crystalline silicon than on quartz or amorphous membranes. The final devices, which are 6 microns thick, are robust and easily mounted into a channel that spans across a waveguide in the waveguide block. With a prototype mixer which uses a corrugated feed, we measured a receiver noise temperature of 1050 K (DSB) at 1.398 THz with an intermediate frequency of 1.5 GHz, using a laser local oscillator source. We are presently scaling the design to 2.7 THz.

REFERENCES

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