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System Performance of NbTiN THz SHEB Waveguide Mixers and Cryogenic SiGe LNA

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***Abstract*—Due to the intrinsic IF 3-dB roll-off frequency of a superconducting hot electron bolometer (SHEB) mixing device of only a few GHz, a large relative IF processing bandwidth with a lower band edge ≤ 1 GHz is important to exploit the full potential of a SHEB receiver. In particular this is mandatory for astronomical measurements in the THz frequency range.**

We present test receiver measurements of several NbTiN THz SHEB waveguide mixers in combination with a newly available 0.3–4 GHz cryogenic low noise amplifier (LNA) based on discrete SiGe heterojunction bipolar transistors. This SiGe LNA is especially suitable for SHEB mixer IF amplification because of its multi-octave bandwidth at low frequencies and low input reflection coefficient. As a result – contrary to current approach for stable SHEB receiver operation – neither an isolator nor a balanced LNA configuration for suppression of the reflected IF power at the amplifier input is required. An isolator severely limits the relative IF bandwidth to less than one octave and balanced amplifiers are too bulky for future array applications, even if one could accommodate the additional dissipation. We investigate the IF frequency response of the test receiver with regard to output power stability (i.e. Allan times), ripple and receiver noise and demonstrate that this receiver configuration is suitable for astronomical operation. With these LNAs the 1.4 THz and 1.9 THz SHEB receiver channels of the German Receiver for Astronomy at Terahertz Frequencies (GREAT) for the Stratospheric Observatory for Infrared Astronomy (SOFIA) and the balloon-borne Stratospheric Terahertz Observatory (STO) will get a substantial enlargement of available IF bandwidth.