Integration of IF Amplifiers with NbTiN SHEB Mixers

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For the 1.4 THz and 1.9 THz channels of the GREAT instrument for SOFIA we have developed waveguide mixers with NbTiN superconducting Hot Electron Bolometer (SHEB) devices on low stress silicon nitride membranes. Comparable mixers will also be used in the balloon-borne Stratospheric Terahertz Observatory (STO). In the current baseline approach for these receivers, the mixer is connected to the low noise IF amplifier by a narrow-band (1.2–1.8 GHz) cryogenic isolator to prevent interactions between the 1–2 GHz amplifier and the mixer. Previous tests have indicated that an isolator is necessary for a stable receiver performance with minimal variations of noise and gain vs. IF frequency. Unfortunately, the isolator has the disadvantage that a significant fraction of the potential IF bandwidth of the mixer and low noise IF amplifier is wasted.

Several approaches are currently being pursued for wide-bandwidth integration of mixers and IF amplifiers and experimental results will be reported at the conference. A first approach is a connection of a Caltech 0.5–11 GHz indium-phosphide LNA directly to the mixer without an isolator; initial results have shown large frequency ripple in the measured receiver noise temperature. The amplifier has excellent noise and flat gain when driven from a 50 ohm generator but does not present a 50 ohm load to the HEB mixer at IF frequencies below 4 GHz. The use of a small attenuator between LNA and mixer will be investigated. Finally, a new silicon-germanium (SiGe) LNA for the 0.3 to 5 GHz range with good input match is under test at Caltech and further tests of integration with the HEB mixer are planned prior to the conference.