Operating of the superconducting integrated receiver channel of the TELIS atmospheric sounder.

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***Abstract*— A Superconducting Integrated Receiver (SIR) was proposed more than 10 years ago and has since then been developed up to the point of practical applications. We have demonstrated for the first time the capabilities of the SIR technology for heterodyne spectroscopy both in the laboratory and at remote operation under harsh environmental conditions for atmospheric research. Within a SIR the main components needed for a superconducting heterodyne receiver such as an SIS-mixer with quasi-optical antenna, a Flux-Flow oscillator (FFO) as the local oscillator, and a harmonic mixer to phase-lock the FFO are integrated on a single chip. Light weight and low power consumption combined with broadband operation and nearly quantum limited sensitivity make the SIR a perfect candidate for future airborne and space-borne missions. The noise temperature of the SIR was measured to be as low as 120 K, with an intermediate frequency band of 4 – 8 GHz in double sideband operation; the spectral resolution is well below 1 MHz. The SIR was implemented in the three-channel balloon-borne instrument TELIS (TErahertz and submillimeter LImb Sounder) that detects spectral emission lines of stratospheric trace gases (like ClO and BrO). These gases even in small quantities can have a significant impact on the atmosphere because they speed up certain chemical processes, such as ozone depletion.**

The SIR is very sensitive to external electromagnetic interference and temperature variations, but specially developed shielding, novel design of the SIR itself and sophisticated operating algorithms provide stable operation of the device. During the flight the SIR should perform extremely stable and reliable – some measurements last about an hour. The changing of the LO frequency for next measurement should be as fast as possible (about 1 min).