Presented at the International Conference on Superconductive Electronics "EuroFlux-2009: from devices to circuits and systems", Avignon, France, September 20-23, 2009.

SUPERCONDUCTING INTEGRATED RECEIVER

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A Superconducting Integrated Receiver (SIR) [1, 2] was proposed more than 10 years ago and finally has been developed for practical applications [3]. A SIR comprises in one chip (size of 4 mm*4 mm*0.5 mm) a low-noise SIS mixer with quasioptical antenna, an flux-flow oscillator (FFO) [4] acting as a Local Oscillator (LO) and a second SIS harmonic mixer (HM) for the FFO phase locking, see Fig. 1. All components of the SIR microcircuits are fabricated in a high quality Nb-AlN/NbN-Nb tri-layer on a Si substrate [5]. The receiver chip is placed on the flat back surface of the silicon lens, forming an integrated lens-antenna. Light weight and low power consumption combined with nearly quantum limited sensitivity and a wide tuning range of the FFO make SIR a perfect candidate for many practical applications. In particular we have developed integrated receiver for novel balloon borne instrument TELIS (Terahertz Limb Sounder) [6]. TELIS is a collaborative European project to build a three-channel heterodyne balloon-based spectrometer for measuring a variety of the stratosphere constituents.

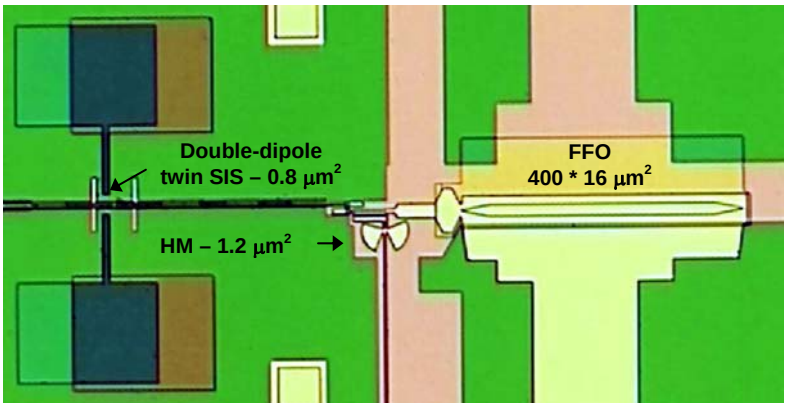

Fig.1 *Central part of the SIR chip with double-dipole antenna, twin SIS-mixer and harmonic mixer for FFO phase locking.*

TELIS is designed to be a compact, lightweight instrument capable of providing broad spectral coverage, high spectral resolution and long flight duration. The TELIS instrument serves also as a test bed for many novel cryogenic technologies. The SIR for TELIS covers frequency range 450 - 650 GHz. As a result of recent receiver's optimization the DSB noise temperature was measured as low as 120 K for the SIR with intermediate frequency band 4 – 8 GHz. The spectroscopic Allan stability time is about 20 seconds; required spectral resolution of about 1 MHz was confirmed by gas cell measurements. Several algorithms for remote automatic computer control of the SIR have been developed and tested. The SIR has been installed into TELIS instrument, and after comprehensive tests integrated in the gondola for the flight, which is currently scheduled for March 2009 in Kiruna, Sweden.

Capability of the SIR for high resolution spectroscopy has been successfully proven in a laboratory environment. Possibility to use the SIR devices for analysis of the breathed out air at medical survey will be discussed. Many of spectral lines very important for such survey and medical analysis are concentrated in the sub-terahertz range and can be detected by such spectrometer.

The work was supported by the projects: RFBR 09-02-00246, 09-02-12172-ofi-m, and Grant for Leading Scientific School 5408.2008.2

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