

# SUPERCONDUCTING PHASE-LOCKED LOCAL OSCILLATOR FOR SUBMM INTEGRATED RECEIVER\*

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## ABSTRACT

Presently a Josephson Flux Flow Oscillator (FFO) appears to be the most developed superconducting local oscillator for integration with an SIS mixer in a single-chip submm-wave receiver [1]. A receiver DSB noise temperature below 100 K has been achieved for a SIR operating the internal FFO in the frequency range 480 - 520 GHz. The feasibility of phase locking a FFO to an external reference oscillator at all frequencies of interest has to be proven because it is vitally important for practical FFO use in high-resolution spectral studies. An increase of the intrinsic linewidth due to an abrupt increase of the internal damping caused by Josephson self-coupling (JSC) effect at voltages  $V > V_{JSC} = V_{gap}/3$  considerably complicates phase locking of the FFO. Comprehensive measurements of the FFO radiation linewidth have been performed using an integrated harmonic SIS mixer. Results on FFO linewidth and spectral line profile have been compared to theory. The influence of FFO parameters on radiation linewidth, particularly the effect of the differential resistances associated both with the bias current and the applied magnetic field has been studied in order to optimize the FFO design. This has resulted in a free-running FFO linewidth  $\leq 10$  MHz in the flux flow regime up to 712 GHz, limited only by the gap value of the Nb-AlO<sub>x</sub>-Nb FFO. This narrow free-running FFO linewidth (compared to all previous measurements) along with the construction of a wide-band PLL system have enabled us to phase lock the FFO in the frequency range 490 – 712 GHz (the flux flow regime) where continuous frequency tuning is possible. An absolute FFO phase noise as low as -73 dBc and -68.7 dBc at 100 kHz offset from the carrier has been achieved at 450 and 707 GHz, respectively. This satisfies the requirements for single dish radio astronomy missions and atmospheric monitoring.

\*The work was supported in parts by the Russian SSP “Superconductivity”, RFBR projects 00-02-16270, the Danish Research Academy, the Danish Natural Science Foundation and a Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO).

## REFERENCES

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