THE FLUX-FLOW OSCILLATOR WITH MIXED INLINE-OVERLAP BIAS

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The flux-flow oscillator (FFO) is a long Josephson junction in which a unidirectional flow of magnetic flux quanta (fluxons) generates millimeter and submillimeter electromagnetic radiation. The FFO is the best on-chip integrated local oscillator (LO) presently employed for superconducting integrated receivers (SIRs) in the framework of the international balloon based mission TELIS. The FFO voltage and thus its frequency is controlled independently by the overlap bias current, Ib, and the so called “control line” inline current, Icl, which creates the magnetic field at the ends of the FFO. In practice (Nb-AlOx-Nb trilayer tunnel junction) this current flows in the bottom electrode along the junction and the FFO can be considered as a device with four current ports. Here we report on an extensive study of both radiation linewidth and DC properties for an FFO with mixed inline-overlap bias. For a given FFO the current ports are systematically interchanged so that all combinations of overlap-inline bias are investigated. In this case where the bias current is applied through the port commonly used for the “control line” current the magnetic field at the corresponding FFO end contains a contribution from Ib that changes the steepness of the I-V characteristic and therefore modifies the FFO bias current differential resistance. Both theoretical and experimental methods have been developed to evaluate the difference in the DC magnetic field at the ends of the junction. Usually the boundary conditions of the two ends are made very different by loading the end emitting the radiation with an RF matching element. Results of experimental studies of the FFO magnetic field misbalance are in good agreement with numerical simulations performed with Sonnet software. The end where fluxons enter the junction appears to be about three times more sensitive to variations of the magnetic field than the radiating end.

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