

Title of the Thesis: *Optimization of high-frequency generators using Josephson junctions.*

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ABSTRACT OF THE THESIS

This thesis is devoted to the study of current singularities in Josephson junction devices. In the first part, analytic and numerical investigations of flux-flow in-phase and anti-phase oscillations in twofold stack Josephson junctions when embedded in a homogeneous and sufficiently high magnetic field are made. The power balance analysis is used showing that when the junctions are dc biased, Fiske singularities are observed and their positions are in agreement with the so-called Swihart velocities. The case where the stack is ac-biased is considered showing the appearance of satellite singularities around the main flux-flow mode. Good agreement is found between analytical results and direct numerical simulations even for relatively strong coupling.

In the second part, investigations on current singularities of overlap type arrays of Josephson junctions are made. Using a well-known cavity mode model, the analytic expression of the IV characteristics is found. Results of direct numerical simulations show close agreement with the analytical treatment. The case where junctions are in the presence of a local and an overall distribution of microdefects is considered. As a result, the presence of microdefects give rise to a somehow coherent behaviour of junctions in the array and a good fraction of the junctions forming the array are oscillating in a phase-locked state.