

Title

Computer simulation of tunneling characteristics of superconducting nanostructures

Introduction

The phase dynamics in superconducting nanostructures has attracted a great attention because of rich and interesting physics from one side and perspective of applications from the other one. The phase dynamics investigations of intrinsic Josephson junctions in high temperature superconductors are interesting in the context of coherent radiation emission.

In during of the project period the student will study the physics of superconducting nanostructures and get the experience in the computer simulation of their physical characteristics.

Description of the project

The students will concentrate on the computer simulation of the phase dynamics in superconducting nanostructures. The example of the current-voltage characteristics (CVC) simulated for the stack with 10 intrinsic Josephson junctions (IJJ) in high temperature superconductor is presented in left figure. The breakpoint shown in the inset is a parametric resonance point where the longitudinal plasma wave is created in this stack. In right figure we demonstrate the profile of the electric charge on the first superconducting layer. The details are in the recommended papers.

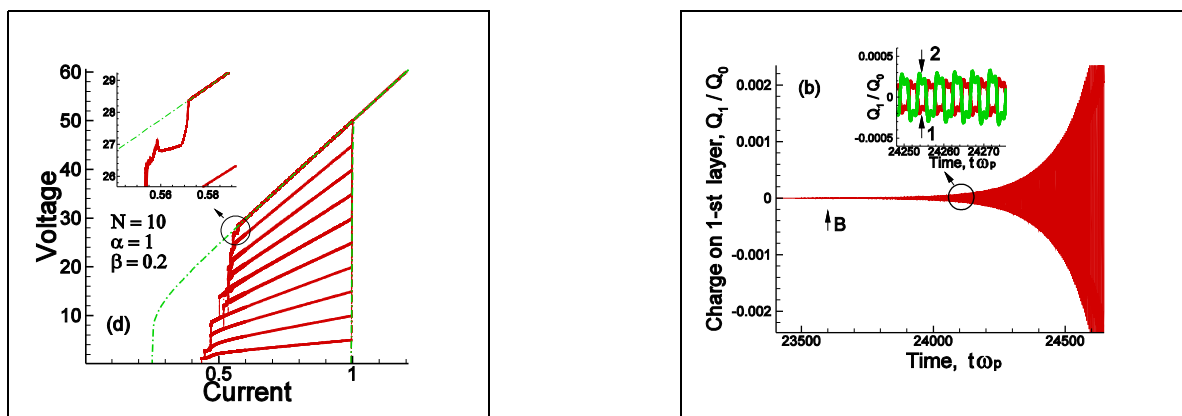


Figure: (Left)- The simulated CVC of a stack of 10 IJJ. The inset shows the enlarged breakpoint region (BPR) for the last branch in CVC. (Right)- Charge oscillation in the first layer in the beginning of B-S part of the BPR. The inset shows the oscillations in the layers 1 and 2.

The problems for students:

1. Investigation of the parametric resonance in superconducting nanostructures under microwave radiation.
2. Comparative study of the CCJJ- and CCJJ+DC-models. Determination of the role of diffusion current in the CCJJ+DC-model.
3. Investigation of the charge imbalance effect in superconducting nanostructures.

Results of the project will be presented in the form of the report, which might be considered as a version for scientific paper.

Acceptance criteria

Experience in computer simulation

Number of the participants

The number of the participants is limited by three students.

Recommended literature

1. Werner Buckel, Reinhold Kleiner. Superconductivity. Fundamentals and Applications, Wiley-VCH, 2004.
2. Yu. M. Shukrinov, F. Mahfouzi. "Influence of coupling between junctions on breakpoint current in intrinsic Josephson junctions", Phys.Rev.Let., 98 (2007) 157001
3. Yu. M. Shukrinov, M. Hamdipour and M. R. Kolahchi. Effect of interjunction coupling on superconducting current and charge correlations in intrinsic Josephson junction. Phys.Rev.B, 80, 014512 (2009)

Supervisor of the project



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