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Stefani Apostolova Panayotova

(University of Plovdiv Paisii Hilendarski, Plovdiv, Bulgaria)

Numerical modeling of Josephson junction with ferromagnet layer in the presence of spin-orbit coupling

We consider the superconductor-ferromagnet-supercoductor Josephson junction (SFS JJ) with a direct coupling between magnetic moment and Josephson current, described by the Cauchy problem for a system of ordinary differential equations. For some values of parameters, the system becomes stiff. So the explicit algorithms failed for numerical solution of this system and special numerical approaches on the basis of implicit methods are required.

In our study, we use both explicit and implicit numerical schemes which have been implemented in the respective interactive software on the basis of Wolfram Mathematica language. In this software, we employ the 4-step explicit Runge-Kutta algorithm and the 4th accuracy order two-stage Gauss–Legendre method.

The influence of parameters of the SFS JJ model on the stiffness of the system is analyzed. Effectiveness of the Gauss–Legendre method in numerical simulation of the SFS JJ system is demonstrated. Results of numerical study of the magnetic precession in dependence on parameters of the SFS JJ model are presented.