

Cherenkov Radiation by Josephson Vortex Chain

A.S. Malishevskii, V.P. Silin, and S.A. Uryupin

P.N. Lebedev Physical Institute, Russian Academy of Sciences, Moscow, Russia

We have established, that periodic vortex chain that travels in the long Josephson junction embedded in a dielectric medium emits high-frequency radiation with line spectrum. The radiation of electromagnetic waves from the lateral surface of the sandwich is attributed to the Cherenkov effect and can occur if the velocity of a moving vortex chain is greater than the speed of light in the dielectric. The dependencies of the frequency and power of the radiation lines on the bias current density, which is distributed over the junction and ensures the uniform chain motion with constant velocity, are found. For typical parameters of Josephson sandwiches conditions under which spectrum of radiation lines falls into the terahertz range are pointed out.

The spectrum of radiation into a medium with relatively high permittivity consists of a discrete set of harmonics. The frequency of the first harmonic is equal to the ratio of chain velocity to its period. The main frequency of Cherenkov radiation increases proportionally with dc voltage and external magnetic field, that posses to rearrange the radiation spectrum smoothly. Since in the discussed structure the generation arises from large lateral surface, the power of terahertz-band is greater than in the case of radiation from the edges of junction. Results are of interest for use of distributed Josephson junctions as generators of monochromatic radiation.

The work was supported by the Presidium of the Russian Academy of Sciences (program no. 22).