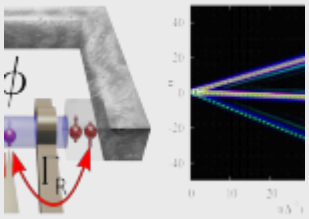
Quench Dynamics in Superconducting Nanojunctions: Formation of Andreev Bound States and Quasiparticle Trapping



Article: published in Physical Review Letters by R. Seoane Souto, A. Martín-Rodero and A. Levy Yeyati, Department of Theoretical Condensed Matter Physics and IFIMAC researchers.

Superconducting junctions at the nanoscale are characterized by the presence of localized excitations lying within the superconducting energy gap, the so-called Andreev bound states. These states are sensitive to the superconducting phase jump through the junction and their population determines the supercurrent flowing through it. Nowadays experiments are allowing to analyze the population dynamics of these devices on very short time scales (below the microseconds), smaller than the typical relaxation times needed to approach the equillibrium conditions. In the present work we analyze the dynamics of quasiparticles in a superconducting nanojunction generated by a sudden quench of a given parameter like the phase or the voltage drop through it. We show that, for general conditions, the system gets trapped in a metastable state corresponding to a non-equilibrium population of the Andreev bound states. Our analysis, based on the so-called full counting statistics technique, reveals that the probability for trapping individual quasiparticles in the junction region can be as large as 50%, in agreement with recent experimental results. [Full article]