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Tuning of dissipation in tunnel-ferromagnetic Josephson junctions

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Josephson coupling between superconducting and ferromagnetic layers is driving new fundamental physics and innovative applications for superconducting electronics and quantum circuits [1,2]. Examples are: the possibility to switch the ground state of a Josephson junction (JJ) from a 0 to a π phase state, the existence of JJs having a doubly degenerate ground state with an average Josephson phase $\psi = \pm\varphi$, the possibility to carry spin-triplet supercurrent in the presence of certain types of magnetic inhomogeneity.

We will report on a comprehensive study of dissipation in hybrid JJs composed by pure metallic ferromagnetic layers [3] or by ferromagnetic-insulator barriers [4,5,6]. Transport measurements highlight different dissipation sources, which reflect different properties of the barriers and of the composition of the junctions. This study provides the electrodynamic characterization [3,6,7] necessary for the possible use of these systems in more complex circuits, as cryogenic memories or spintronic devices, and suggests new solutions of ferromagnetic JJs in superconducting qubits.

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