Contribution ID : **16** Type : **contributed oral**

Low temperature characterization of low-dissipation ferromagnetic Josephson junctions

giovedì 20 giugno 2019 12:30 (15)

Ferromagnetic Josephson junctions present a rich emerging physics due to the coupling between ferromagnetism and superconductivity. The interplay between the two competing phases causes an oscillation of the superconducting order parameter within the ferromagnetic barrier, which is responsible for the appearance of a π ground state, and of triplet correlations in the Josephson junction [1,2]. Because of such properties, SFS junctions are sought to have applications in the emerging field of superconducting spintronics [3] and in quantum and digital superconducting computation as phase shifters [4] or as auxiliary circuit elements for error correction, readout and memory elements [5, 6, 7, 8]. Currently, their use is limited by their metallic, highly dissipative nature. In this work we will review the properties of a specific category of SFS, namely low dissipation spin filter junctions [9,10]. In particular, we will present a low temperature characterization of such devices down to 0.3K. We measured several junction parameters as a function of thickness, focusing our attention on critical current versus temperature dependencies at different thicknesses. We developed a model to describe the anomalous behaviour and the incomplete 0-π transition found in experimental data using short-range triplet correlations. These results offer new perspectives for the study of the role of short-range triplet correlations in the transport properties of low dissipation ferromagnetic junctions.

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Session Classification : session 3