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Spin transport with supercurrents

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Superconductivity and magnetism are antagonistic phenomena, but in certain scenarios they can coexist thank to the formation of triplet Cooper pairs (opposed to singlet Cooper pairs in conventional superconductivity). We earlier reported on spin-polarized supercurrents generated in the halfmetallic perovskite manganite $La_{0.7}Sr_{0.3}MnO_3$ (LSMO), using superconducting NbTi as contacts and disk-like junctions with a small length of 20 nm between the contacts [1]. We also reported on a method to fabricate bar-shaped lateral junctions, where we found supercurrents over lengths up to 1.3 µm between the contacts [2]. Recently, we extended our investigations of the long length junctions and confirmed that we can fabricate junctions with high supercurrent densities j c even over more than 2 µm. Surprisingly, the critical current is non conventional, and the mechanism for triplet generation in is not yet understood, although it is clear that the S/F interface has to be instrumental to the mechanism. In this talk, I will focus on LSMO/Pt/NbTi devices where we find clear proximity effects over long lengths.

1. J. Yao, R. Fermin, M. Cabero, K. Lahabi and J. Aarts, Phys. Rev. Res. 6, 043114 (2024).

2. J. Yao and J. Aarts, Appl. Phys. Lett. 24, 202601 (2024.)