Current distributions and conductance oscillations in stripe Majorana junctions

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We address the physics of Majorana states in hybrid semiconductor-superconductor nanowires of 2D geometry. Specifically, we describe current and density distributions in stripe (2D planar) junctions between normal and Majorana nanowires having a finite (y) transverse length. In presence of a magnetic field with vertical and in-plane components, the y-symmetry of the charge current distribution in the normal lead changes strongly across the Majorana phase transition. Our analysis is based on the spin, quasi-particle and charge distributions of density and current. The Majorana mode causes opposite spin accumulations on the transverse sides of the junction and the emergence of a spin current.

The usual magnetoconductance oscillations of a 2D NS nanowire junctions in perpendicular magnetic fields are completely suppressed when the superconductor side enters a topological phase. This suppression can be explained by the modification of the vortex structure of local currents at the junction caused by the topological transition of the superconductor. In practice, the two regimes (with and without oscillations) could be seen with an L-shaped junction in a uniform magnetic field, properly choosing the nanowire width. We predict similar oscillations and suppression as a function of the Rashba coupling (as tuned by an external potential gate). The oscillation suppression is robust against potential biases and against lateral phase differences of the superconductor.

[1] J. Osca, L. Serra, "Topological suppression of magnetoconductance oscillations in NS junctions", arXiv:1701.03082.

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[3] J. Osca, L. Serra, "Majorana states and magnetic orbital motion in planar hybrid nanowires", Phys. Rev. B 91, 235417 (2015).