Majorana Fermions in high Tc superconducting hybrid devices

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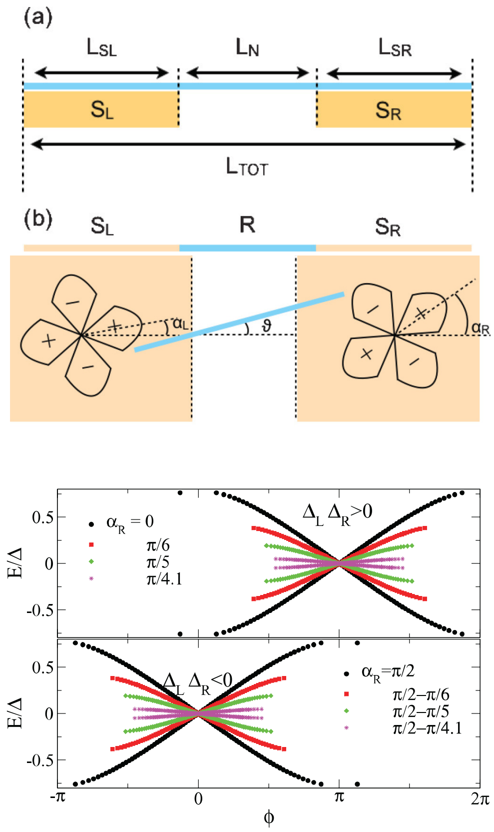
Phys. Rev. B 86, 144513 (2012)



(a) Side view of the superconductor-InAs nanowire - superconductor heterostructure. (b) Top view of the structure and effective one-dimensional model.
Bottom panel) Energy spectrum of zero-energy Majorana bound states in the case of equal (opposite) sign gaps (in top and bottom panel, respectively).

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Majorana Fermions have been predicted in a wide class of low-dimensional solid-state devices. Many of the proposals make use of superconductors in contact with topological insulators or quasi one-dimensional materials with strong spin-orbit interaction. We propose an alternative platform based on high-critical-temperature cuprate superconductors in the in the S/R/S configuration (Superconductor – Rashba semiconductor - Superconductor). Superconductivity induced by proximity effect, by a high-critical temperatures superconductor, in nanowires with strong spin orbit coupling, gives rise to a wider and more robust range of conditions to stabilize Majorana Fermions due to the large gap values.

It is well established that in order to obtain MBSs, in S/R/S heterostructures, the magnetic field has to dominate over the superconductivity. Still, a sizable superconducting gap is needed, as the smaller energy between the magnetic and the superconducting gap sets the minimum energy sufficient to wash out the topological protection of the Majorana excitation. In this respect, HTS appear to offer more chances in stabilizing MBSs. d-wave systems can offer novel functionalities in the design of the experiments determined by different dispersion for Andreev bound states as a function of the phase difference.