

Formation and detection of Majorana modes in quantum spin Hall trenches

We propose a novel realization for a topologically superconducting phase hosting Majorana zero modes on the basis of quantum spin Hall systems. Remarkably, our proposal is completely free of ferromagnets. Instead, we confine helical edge states around a narrow defect line of finite length in a two-dimensional topological insulator. We demonstrate the formation of a new topological regime, hosting protected Majorana modes in the presence of s-wave superconductivity and Zeeman coupling. Interestingly, when the system is weakly tunnel coupled to helical edge state reservoirs, a particular transport signature is associated with the presence of a non-Abelian Majorana zero mode.

The experimental relevance of the setup is due to the fact that very recently quantum point contacts between helical edges have been realized. The transport properties of such structures will also be briefly addressed. Particular attention will be devoted to the so called 0.5 anomaly characterizing the linear conductance.