New progresses in topological superconductors by proximity effect

Jia Jinfeng*[1]

[1]Key Laboratory of Artificial Structures and Quantum Control (Ministry of Education), School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai 200240 – China

Abstract

Topological superconductors attract lots of attentions recently, since they are predicted to host Majorana zero mode (MZM), who behaves like Majorana fermion and can be used in fault-tolerant quantum computation relying on their non-Abelian braiding statistics. Currently, most topological superconductors are artificially engineered based on a normal superconductor and the exotic properties of the electronic surface states of a topological insulator. Here, I will show you that the Bi2Te3/NbSe2 hetero-structure is an ideal artificial topological superconductor. By using spin-polarized scanning tunneling microscopy/spectroscopy (STM/STS), we observed the spin dependent tunneling effect, which is a direct evidence for the spin selective Andreev reflection from MZMs, and fully supported by theoretical analyses. Recently, the segmented Fermi surface induced by the Cooper pair momentum was observed in a Bi2Te3/NbSe2 system. It's found that the shape and size of this Fermi surface can be adjusted by the direction and magnitude of the magnetic field, and can also modulate the topology to build new topological superconductors. This work opens up a new method to manipulate the property of crystals. Finally, the strong proximity effect was found in SnTe-Pb heterostructure. The bulk pairing gap and multiple in-gap states induced by topological surface states can be clearly distinguished. The superconductivity of SnTe is consistent with a new type of topological superconductors under the protection of lattice symmetries. Under lattice-symmetry protection, the superconducting SnTe is predicted to possess multiple MZMs in a single vortex. This system provides a platform to study the coupling of multiple MZMs without the need of real space movement of a vortex.

*Speaker