SS-03-2-I-M

Observation of Majorana fermions in the vortex of topological superconductor

Jin-Feng JIA*

Department of Physics and Astronomy, Shanghai Jiao Tong University, China

jfjia@sjtu.edu.cn

Majorana fermion (MF) whose antiparticle is itself has been predicted in condensed matter systems. Signatures of the MFs have been reported as zero energy modes in various systems. More definitive evidences associated with MF's novel properties are highly desired to verify the existence of the MF. Recently, theory has predicted MFs have a spatial distribution and can induce spin selective Andreev reflection (SSAR), a novel magnetic property which can be used to detect the MFs. Here I will talk about our efforts to identify MFs in the vortex core of topological insulator/superconductor $Bi_2Te3/NbSe_2$ hetero-structure, in which topological superconductivity was previously established. We systematically investigated the spatial profile of the Majorana mode and the bound quasiparticle states within a vortex in $Bi_2Te3/NbSe_2$. A special splitting behavior is observed on the zero bias peak, which can be well explained by existence of MF. By using spin-polarized scanning tunneling microscopy/spectroscopy (STM/STS), we show that the zero-bias peak of the tunneling differential conductance at the vortex center is substantially higher when the tip polarization and the external magnetic field are parallel than anti-parallel to each other. Such strong spin dependence of the tunneling is absent away from the vortex center, or in a conventional superconductor. The observed spin dependent tunneling effect is a direct evidence for the SSAR from MFs, fully consistent with theoretical analyses. Our work provides definitive evidences of MFs and will stimulate the MFs research on their novel physical properties, hence a step towards their statistics and application in quantum computing.