Condensed Matter Seminar

Superconductivity in topological insulator films for Majorana fermions detecting and 2D TI Bi films

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In the first part of my talk, I will report scanning tunneling microscopy (STM) observation of superconductivity in topological insulator thin films grown on BCS type s-wave superconductor $NbSe_2$ by molecular beam epitaxy (MBE) technique. Our data show that the Cooper pairs formation persists in the thickness regime from one quintuple layer (QL) up to seven QLs of Bi_2Se_3 at which topological order forms. Recently, we also observed Abrikosov vortices and Andreev bound states in the proximity effects induced topological superconductor $Bi_2Te_3/NbSe_2$. This observation lays the groundwork for experimentally realizing Majorana fermions in condensed matter physics. In the second part, I will report observation of quasi-particle spectrum with skewed Dirac cone in a single Bi bilayer grown on Bi_2Te_3 substrate, from angle-resolved photoemission spectroscopy (ARPES), showing direct evidence of many-body interactions. Density function theory band calculations and theoretical analyses reveal that the quasi-particle spectra manifest electron-electron interactions arising from hybridization between the substrate-induced Dirac states of Bi bilayer and the surface Dirac states of Bi_2Te_3 film at close energy proximity. Without the hybridization, only single-particle Dirac spectra are observed in a single Bi bilayer grown on Bi_2Se_3. Our findings open a door to studying many-body physics in a novel material system of TIs with spin-polarized Dirac fermions.

In cooperation with Mei-Xiao Wang, Canhua Liu, Jin-Peng Xu, Fang Yang, Lin Miao, Z. F. Wang, Meng-Yu Yao, C. L. Gao, Chenyi Shen, Xucun Ma, X. Chen, Zhu-An Xu, Feng Liu, Ying Liu, Shou-Cheng Zhang, Dong Qian and Qi-Kun Xue

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