Resolving the band structure of topological insulators and point-contact spectroscopy analysis

PAVEL SHIBAYEV, Princeton Univ, HASAN GROUP TEAM

— This study concerns a comprehensive quantitative analysis of topological insulators (TIs) [1], a new quantum state of matter, namely Bi$_2$Se$_3$. The first stage is observing the proximity-induced superconductivity effect [2] via point-contact spectroscopy (PCS). Differential conductance of the superconducting NbSe$_2$ crystal was measured at approximately 4 K, cooled with liquid helium. Through the analysis of I-V characteristics, it was possible to observe an expected behavior of differential conductance for voltages higher than 1 mV, and the ongoing work is to observe this effect at lower voltage. Subsequently, this method will be used to induce superconductivity in Bi$_2$Se$_3$ by combining it with NbSe$_2$. The second stage is a first-principles calculation of band structure of the TI crystal based on the density functional theory, DFT, performed on Bi$_2$Se$_3$ using the ABINIT program [3]. The third stage is resolving the band structure of the crystal via angle-resolved photoemission spectroscopy (ARPES) at a synchrotron facility and comparing with the above calculation. It is expected to be completed in February 2014.


1Group led by Professor Zahid Hasan