The Quantum Anomalous Hall effect in Magnetically Doped Topological Insulators

Qi-Kun Xue, *Department of Physics, Tsinghua University*

The quantum anomalous Hall (QAH) effect is a quantum Hall effect induced by spontaneous magnetization instead of an external magnetic field. It is the foundation for applications of dissipation-less quantum Hall edge states in low-energy-consuming devices and for realization of novel quantum phenomena such as chiral topological superconductivity and axion electrodynamics. The QAH phase can be realized a ferromagnetic topological insulator (TI) film as a result of magnetically induced gap at the Dirac surface states. With molecular beam epitaxy techniques, we have prepared thin films of Cr-doped $(Bi,Sb)_2Te_3$ and Cr/V co-doped Sb_2Te_3 TIs with well-controlled composition, thickness and chemical potential and obtained ferromagnetic insulator phase in them. In such magnetic TI films, we have experimentally observed the quantization of the Hall resistance at h/e^2 at zero magnetic field. The temperature, thickness and magnetic-doping-level dependence of the QAH effect have been systematically studied, which clarifies the roles of the band structure, electron localization and magnetic order in the effect and provides clues for obtaining high temperature QAH materials.

BIO: Qi-Kun Xue, received his BSc in Shan-Dong University in 1984, and PhD degree in condensed matter physics from Institute of Physics, the Chinese Academy of Sciences (CAS) in 1994. From 1994 to 2000, he worked as a Research Associate at IMR, Tohoku University, Japan and a visiting Assistant Professor at Department of Physics, North Carolina State University, USA. He became a professor at Institute of Physics, CAS in 1999. He was elected into The Chinese Academy of Sciences in 2005. Since 2005, he has been a professor in Department of Physics, Tsinghua University. From 2010 to 2013, he was the Chair of Department of Physics and the Dean of School of Sciences. He became the Vice President for Research in May 2013, Tsinghua University. He won the TWAS Prize in Physics in 2010.

His research interests include scanning tunneling microcopy/spectroscopy, molecular beam epitaxy, low-dimensional and interface-related superconductivity, topological insulators, and quantum size effects in various low-dimensional structures. He has authored/coauthored ~410 papers. He has presented more than 100 invited/keynote/plenary talks at international meetings/conferences, such as American Physical Society March Meeting (1996, 2005, 2010, 2012, 2014). Currently, he is the Editors-in-Chief of Surface Review & Letters, and on the Editorial Board of Physical Review B, Applied Physics Letters, Journal of Applied Physics, Surface Science Reports and AIP Advance.