17 Dec Friday 1:30 – 2:15 Chair: ARIANDO

Realization and Control of 1D Massless Dirac Fermions

Professor XU Nan (徐楠), Wuhan University, China

Professor XU Nan got his Ph.D degree in 2013, from Prof. Hong Ding's group in Institute of Physics, Chinese Academic of Sciences. After a 2-year post-doc in Swiss Light Source, Paul Scherrer Institut with Professor Ming Shi, he was hired as a joint post-doc working with Prof. Joel Mesot and Prof. Ming Shi, at Paul Scherrer Institut and École polytechnique fédérale de Lausanne. From September 2017, he joined Wuhan University, institute of advanced studies, as an assistant professor. He defines himself as a spectroscopist investigating the electronic structures and emerging phenomena of novel quantum states, including low-dimension system, topological insulators, Weyl semimetals, strongly correlated systems and superconductors.

Abstract:

One or a few layers of vdW materials are promising for applications in nanoscale electronics. Established properties include high mobility in graphene, a large direct gap in monolayer MoS2, the quantum spin Hall effect in monolayer WTe2 and so on. These exciting properties arise from electron quantum confinement in the two-dimensional limit. We use angle-resolved photoemission spectroscopy to reveal directional massless Dirac fermions due to one-dimensional (1D) confinement of carriers in the layered vdW material NbSi0.45Te2 [1]. The 1D directional massless Dirac fermions are protected by non-symmorphic symmetry, and emerge from a stripe-like structural modulation with long-range translational symmetry only along the stripe direction as we show using STM. The 3D long-range order can recover by tuning the Si stoichiometry, and we observed that the in NbSi1/3Te2 system evolve into a symmetry guaranteed weak topological insulator phase with spin-polarized topological surface states [2]. By increasing the Si concentration, the band crossings are released in NbSi1/2Te2 system and we observed a narrow gap semiconductor phase [3]. Therefore, we provide a vdW material platform NbSixTe2 for realization of the 1D massless Dirac fermions and tailoring the system through topological phase transitions.

References

[1] Nat. Mater. 19, 27 (2020).
[2] PRB 103, 165107 (2021).
[3] To be submitted.