复旦大学物理系 Colloquium

Time: 11:00, Tuesday, 2021.11.23

Location: Room C108, Jiangwan Physics Building

Quantum Anomalous Hall Effect In Magnetic Topological Insulator Multilayers

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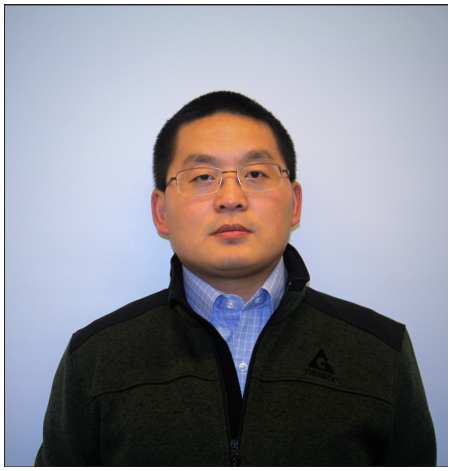
Abstract: A central theme in condensed matter physics is to create and understand new exotic states of matter. One recent example is the quantum anomalous Hall (QAH) state. The QAH effect can be considered as a zero magnetic field manifestation of the integer quantum Hall effect, which can be realized by time-reversal symmetry breaking in a topologically non-trivial system. A QAH system carries spin-polarized dissipation-free chiral edge current. Therefore, the QAH effect may have a considerable impact on future electronic and spintronic device applications for ultralow-power consumption. In 2013, the QAH effect was observed in the Cr-doped topological insulator (TI) thin films for the first time [1]. Two years later in a near-ideal system, V-doped TI, contrary to initial negative prediction from first-principle calculations, a high-precision QAH effect was demonstrated [2]. In this Colloquium, I will briefly talk about the route to the QAH effect in magnetically doped TI films/heterostructures. I will focus on our recent progress on magnetic TI multilayer heterostructures from the axion insulator physics [3] to tuning the Chern number in QAH insulators [4]. In the last part of my talk, I will discuss interesting physics and potential applications enabled by the QAH insulators with high tunable Chern numbers.

References:

[1] Chang et al, Science 340, 167(2013).
[2] Chang et al, Nature Mater. 14, 473(2015).
[3] Xiao et al, Phys. Rev. Lett. 120, 056801 (2018).
[4] Zhao et al, Nature 588, 419 (2020).



Biography: Dr. Cui-Zu Chang is a Henry W. Knerr Early Career Professor in the Department of Physics at The Pennsylvania State University. Chang received his Ph.D. in Physics in 2013 from Tsinghua University(China). Before joining Penn State, he did 4-year postdoctoral work at MIT. Chang is a world-leading expert in the molecular beam epitaxy (MBE) growth of quantum materials, particularly the quantum anomalous Hall (QAH) insulators. Chang was the first to realize the QAH effect using a magnetically doped topological insulator thin film in 2013. His recent interests include the pursuit of high temperature and high Chern number QAH insulators and the exploration of Majorana physics in the QAH-superconductor hybrid structures. His awards include Rustum and Della Roy Innovation in Materials Research Award (2021), Gordon and Betty Moore EPiQS Materials Synthesis Investigator Award (2019), Macronix Prize (Outstanding Chinese Young Researcher Award, 2019), NSF CAREER Award (2019), ARO-Young Investigator Program Award (2018), Alfred P. Sloan Research Fellowship (2018), and IUPAP Young Scientist Prize (2016).