PRSE Magnetics Seminar

“Fundamental properties of strongly correlated and magnetic topological insulators by angle-resolved photoemission at 1 K”

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Lory Student Center, Room 310

Abstract

Topological insulators give rise to topologically protected metallic surface or edge states. In this talk, these systems will at first be introduced from a band structure perspective. Although it does not at all require electron correlation, a topological insulator driven by strong electron correlation would have interesting practical and fundamental implications. Nevertheless, 10 years after its prediction it is still unclear whether such system exists. The by far most studied candidate is samarium hexaboride (SmB_6). It is shown by low-temperature ARPES and STM that its surface states and surface metallicity are of trivial origin [1,2].

Ferromagnetic topological insulators have been used to demonstrate the quantum anomalous Hall effect (QAHE). In electronic devices, the QAH edge states may be used for lossless interconnects, for lossless edge channel spintronics, or for topological qubits. So far, stable 3+ impurities (Cr, V) in $(Bi, Sb)_2Te_3$ topological insulators have been the mainstream approach but with these materials the QAHE is limited to 1 K. Moreover, the magnetic gap at the Dirac point of topological insulators, which is believed to host the chiral edge states, has never been observed directly. We use low-temperature ARPES to reveal the magnetic gap of Mn-doped Bi_2Te_3 films which, moreover, is 5 times larger than predicted. This enhancement is due to a remarkable structure modification induced by Mn doping towards a so-called intrinsic magnetic topological insulator [3].

[1] P. Hlawenka et al., *Samarium hexaboride is a trivial surface conductor*, Nat. Commun. 9, 517 (2018).

[2] H. Herrmann et al., *Contrast Reversal in Scanning Tunneling Microscopy and Its Implications for the Topological Classification of* SmB_6, Adv. Mat. 1906725 (2020).

[3] E. D. L. Rienks et al., *Large magnetic gap at the Dirac point in* $Bi_2Te_3/MnBi_2Te_4$ *heterostructures,* Nature 576, 423 (2019).