Discovery of topological surface states in $PdTe_2$ electronic structure

J. W. Chen[1], C. N. Kuo[1], W. C. Chen[2], C. S. Lue[1], C. H. Chen[3], C. M. Cheng[3], T. R. Chan[1] and C. L. Wu[1]

[1]National Cheng Kung University, Taiwan; [2]National Tsing Hua University, Taiwan; [3]National Synchrotron Radiation Research Center, Taiwan

paul005paul005@gmail.com

Abstract

Topological band structure in superconductor is one of platform for realizing Majorana bound state and other exotic physical phenomena in condensed-matter physics. The topological surface state has been demonstrated in the three-dimensional topological insulator Bi_2Se_3 [1-3] and related compounds, however rarely discovered in superconducting transition metal dichalcogenides (TMDs). The TMDs has been a rich playground to discover new material property, but there are very few reports related to the discovery of topological band structures. In this work, we investigate the topological band structure of TMD superconductors, like $PdTe_2$ crystal, by using combined method of angle-resolved photoemission spectroscopy (ARPES) and density functional theory (DFT). We observe a pair of symmetry-protected Dirac point along k_z direction, which reveals exotic type II band dispersion that strongly violate Lorentz symmetry. In addition, our DFT calculations predict $PdTe_2$ possesses an unexpected $\mathbb{Z}2$ topological invariant and fully spin-polarized Dirac surface states without any doping introducing or external pressure applying. This type of intrinsic topological Dirac superconducting insulator holds a great promise for studying aspects of topological superconductor as well as Majorana zero modes.

Keywords **– TMDs, density functional theory (DFT), angle-resolved photoemission spectroscopy (ARPES)**

References

[1] H. Zhang, et al., *Nat. Physics* 2009, **5**, 438-442.
[2] Y. Liu, et al., *Nat. Physics* 2014, **10**, 294-299.
[3] Y. Zhang et al., *Nat. Physics* 2010, **6**, 584-588.