Robust edge states in stanene on a kagomé antiferromagnet

Zengle Huang[1], Zhiming Xu[2], Jiaqiang Yan[3], Brian C. Sales[3], Yong Xu[2], and Weida Wu[1]

[1]Department of Physics & Astronomy, Rutgers University, Piscataway, New Jersey 08854, USA
[2] State Key Laboratory of Low Dimensional Quantum Physics,Department of Physics, Tsinghua University, Beijing, China
[3]Materials Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831, USA

Weida Wu
Professor
1Department of Physics & Astronomy
Rutgers University

Research site:
http://www.physics.rutgers.edu/~wdwu/

Abstract

The antiferromagnetic metal FeSn with kagomé lattice has been a versatile playground of flat bands and Dirac fermions that could host exotic topological electronic states [1-4]. However, the spacing stanene layer, a honeycone lattice of tin atoms, has been largely neglected. Two-dimensional (2D) stanene has been proposed to be a large-gap quantum spin Hall insulator [5], which triggered intensive experimental investigation on monolayer stanene films [6]. In this talk, we will present the discovery of robust edge states in the stanene layer on the surface of kagomé antiferromagnet FeSn using scanning tunneling microscopy/spectroscopy. The observed edge states are independent of the edge orientation and persist in elevated temperatures. Our theoretical analysis reveals that the surface stanene with in-plane spin polarization is a 2D half-Dirac semimetal hosting robust edge states connecting two Dirac points near Fermi energy, in excellent agreement with the experimental observation. Our results suggest that the surface stanene layer in FeSn is a highly tunable platform to explore 2D topological states of matter.

References

[1] Tang, E., Mei, J.-W. & Wen, X.-G. Phys. Rev. Lett. **106**, 236802 (2011).
[2] J.-X. Yin, et al, Nature Communications, **11**, 4003 (2020).
[3] M. Kang, et al, Nature Materials, **19**, 163 (2020).
[4] Z. Lin, et al, Physical Review B, **102**, 155103 (2020).
[5] Y. Xu, Z. Gan, and S.-C. Zhang, Phys. Rev. Lett., **112**, 226801 (2014).
[6] C. X. Zhao and J. F. Jia, Front. Phys. 15(5), 53201 (2020)