

Design, Synthesis and Characterizations of Topological Quantum Materials

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**Chemistry
Seminar on
Topological
Quantum Materials**

**Monday
Oct 19 at 4
pm in 126
Schrenk**

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Abstract: With ongoing advances in the synthesis of high-quality epitaxial atomic layers and heterostructures, new opportunities are emerging to explore novel physics in low-dimensional quantum materials. In this talk, I will discuss two novel quantum states recently observed in two-dimensional materials. (1) A two-dimensional Weyl/half-Dirac semimetal has been observed in epitaxial Bi monolayer [1]. The spin-polarized massless bulk bands and the topological Fermi string edge states offer new insights into the topological properties of relativistic electrons in reduced dimensions [2]. Furthermore, coupling a 2D Weyl semimetal to superconductors can give rise to a higher-order topological superconducting phase, accompanied by the emergence of Majorana corner states. [3]. (2) Altermagnetic (AM) compounds have recently emerged as a promising platform for realizing unconventional quantum phases, enabled by their unique spin-split band structure at zero net magnetization. We present a first-principles investigation of magnetically intercalated transition metal dichalcogenides (TMDs) of the form XY_4Z_8 [4]. The results collectively establish magnetically intercalated TMDs as a versatile materials platform for engineering altermagnetism, flat bands, and Weyl fermions within a single material family.

References:

- [1] Q. Lu *et al.*, *Nature Communications* **15**, 6001 (2024)
- [2] D. J. P. de Sousa *et al.*, *Physical Review Letters* **133**, 146605 (2024)
- [3] C.-K. Chiu *et al.*, arXiv:2412.06150
- [4] A. Sah *et al.*, *npj Quantum Materials* **11**, 63 (2026)

About the speaker: Guang Bian is an associate professor at the Department of Physics and Astronomy, University of Missouri, Columbia. He received his Ph.D. at University of Illinois at Urbana-Champaign under the supervision of Prof. Tai-Chang Chiang in 2013. He was a postdoctoral fellow at Princeton University working with Prof. M. Zahid Hasan in 2013-2016. He joined University of Missouri as an assistant professor in 2016 and became an associate professor in 2022. Dr. Bian has extensive experience in molecular beam epitaxy (MBE) fabrication and spectroscopic characterization of low-dimensional quantum materials, with over 130 publications. Dr. Bian's research work has been funded by agencies including NSF, DOE and Moore Foundation, and recognized by "Aladdin Lamp Award" from Synchrotron Radiation Center, Wisconsin (2010) and "Gordon and Betty Moore Foundation Experimental Physics Investigator Award" (2023).

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