Wandering in the Flatland: Novel 2D Dirac/Weyl Materials

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The discovery of graphene has stimulated enormous interest in two-dimensional (2D) electron gas with linear band structure. 2D Dirac materials possess many intriguing physical properties such as high carrier mobility and zero-energy Landau level for the relativistic dispersion and chiral spin/pseudospin texture. In this talk, we will discuss three new variants of 2D Dirac materials including (1) unpinned 2D Dirac semimetals in α-antimonene[1,2], (2) Rashba spin-split 2D Weyl semimetals in α-bismuthene[3], and (3) interacting Dirac states in graphene heterostructures[4]. The results offer new insights to the relativistic behavior of electrons in reduced dimensions. We will review the emergent properties and device applications of relativistic electrons in those 2D Dirac/Weyl semimetals, especially, cloning of Dirac fermions, Moiré flat bands, and spin/valley separators.

Reference:

[1] Lu *et al.*, Nat. Commun. **13**:4603 (2022)
[2] Kowalczyk *et al.*, ACS Nano **14**, 1888 (2020)
[3] Lu *et al.*, submitted (2022)
[4] Lu *et al.*, Advanced Materials 2200625 (2022)

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Guang Bian is an associate professor at the department of physics and astronomy, University of Missouri, Columbia. Dr. Bian has extensive experience in molecular beam epitaxy (MBE) fabrication and spectroscopic characterization of low-dimensional quantum systems and novel topological/functional materials. Dr. Bian's research work has been recognized by "President's Early Career Award", University of Missouri (2019), "Aladdin Lamp Award", Synchrotron Radiation Center, Wisconsin (2010), and "Highly Cited Researcher" (2019-2022) by Clarivate Analytics. Dr. Bian has published 112 papers on quantum materials in peer-reviewed journals with >15,000 citations and *h*-index of 48 according to Google Scholar.
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