北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Layertronics and quantum geometric properties in twisted bilayers

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Time: 10: 00 am, Nov. 30, 2023 (Thursday)

时间：2023年11月30日 （周四）上午10:00

Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

This talk will discuss quantum geometric properties of electrons in twisted homobilayer semiconductors arising from the layer pseudospin when twisting introduces its texture in real and momentum spaces. In small angle twisted TMDs, real-space Berry curvature from the moire-patterned layer pseudospin texture realizes an effective magnetic field [1] that underlies the emergence of quantum anomalous Hall effects recently observed in twisted MoTe2. The gate tunable ferromagnetic QAH at filling factor 1 further implies the existence of an altermagnetic orbital Chern insulator at filling factor 2, where sizable orbital magnetization makes possible field initialization of spin Neel order and Chern number [3], with the sign of Chern number electrically switchable at zero magnetic field. I will also discuss linear and nonlinear responses of quantum geometric origins from momentum space layer texture, including the time-reversal even linear Hall counter flow [4], nonlinear dynamical Hall effect of a crossed geometry [5], and interlayer electric multipoles driven by in-plane electric field [6].

[1] H Yu, M Chen, W Yao, Giant magnetic field from moire induced Berry phase in homobilayer semiconductors, Natl. Sci. Rev., doi: 10.1093/nsr/nwz117, Epub 2019 Aug 13

[2] F Fan, C Xiao, W Yao, Altermagnetic Orbital Chern Insulator in Twisted MoTe2, arXiv:2308.11454.

[3] D Zhai, C Chen, C Xiao and W Yao, Time-reversal even charge hall effect from twisted interface coupling, Nature Comm. 14, 1961 (2023).

[4] C Chen, D Zhai, C Xiao, W Yao, Crossed Nonlinear Dynamical Hall Effect in Twisted Bilayers, arXiv:2303.09973.

[5] H Zheng, D Zhai, C Xiao, W Yao, Interlayer electric multipoles induced by in-plane field from quantum geometric origins, arXiv:2311.11710.

About the speaker

Wang YAO obtained his BSc from Peking University in 2001, and PhD in physics from University of California, San Diego in 2006. He joined the University of Hong Kong in 2008, and rose through the academic ranks to Chair Professor of Physics in 2019. He is also a New Cornerstone Investigator. His group works in an interdisciplinary area across condensed matter physics, quantum physics, and optical physics, with current research interest in spin and pseudospin phenomena in 2D quantum materials and their layered structures. He has received honours including the OCPA Achievement in Asia Award, Nishina Asia Award, XPlorer Prize, Huang Kun Prize, and has been named by Clarivate Analytics in the list of "Highly Cited Researchers" in consecutive years from 2018 to 2023. He is also elected Fellow of American Physical Society and Fellow of Optica.