Seminar

2D Theoretically Twistable Material Database and New Moiré Platform Based on M-Point Twisting

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Time: 11:15 am, July.4, 2025 (Friday)

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Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

The study of twisted materials has opened new opportunities for investigating topological phases and strongly correlated physics. Beyond well-known cases such as twisted bilayer graphene (TBG) and twisted transition metal dichalcogenides (TMDs), many other twistable 2D materials remain largely unexplored. In this talk, I will introduce our recent works on exploring new moire systems.

Based on the Topological 2D Materials Database (2D-TQCDB), we develop a high-throughput algorithm to search for theoretically twistable — single- or multilayer systems whose moire structures can be described by simple continuum models. I will highlight representative candidates, show their twisted-bilayer band structures, and introduce corresponding simplified continuum models.

In particular, we introduce a new class of moiré systems based on triangular lattices with low-energy states at the M points of the Brillouin zone. By performing large-scale ab-initio simulations on twisted 1T-$SnSe_2$ and 1T-ZrS_2, we develop quantitative continuum models and show that the corresponding M-point moire Hamiltonians exhibit emergent momentum-space nonsymmorphic symmetries and a kagome plane-wave lattice in momentum space. Furthermore, the non-symmorphic momentum-space in-plane mirror symmetry makes some of the M-point moiré Hamiltonians quasi-one-dimensional in each valley, suggesting the possibility of realizing Luttinger liquid physics.

[1] Jiang Yi, et al. "2D Theoretically Twistable Material Database." arXiv:2411.09741 (2024).

[2] Călugăru Dumitru, Jiang Yi, Hu Haoyu, Pi Hanqi, et al. "A New Moire Platform Based on M-Point Twisting." arXiv preprint arXiv:2411.18684 (2024)

About the speaker

Dr. Hanqi Pi received her Ph.D. from the Institute of Physics, Chinese Academy of Sciences, in 2024, and then worked as a postdoctoral researcher at the Donostia International Physics Center, under the supervision of Prof. Maia Vergniory and Prof. Andrei Bernevig. Her research centers on the computational and theoretical study of condensed matter physics, with a particular emphasis on the topological, nonlinear optical, and transport properties of exotic quantum systems.