Topological Minibands in Moiré Superlattice Materials with Strong Spin-orbit Coupling

(Session B, Oral)

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The emergence of topologically non-trivial flat bands in moiré materials provides an opportunity to explore the interplay between topological physics and correlation effects, leading to the recent experimental realization of interacting topological phases, e.g. fractional Chern insulators, in graphene moiré materials and transition metal dichalcogenides moiré superlattice. In this talk, I will go beyond these existing moiré materials and discuss how to engineer topological flat minibands in 2D materials with moire superlattice potentials and strong spin-orbit coupling. Particularly, we propose (1) topological minibands in topological insulator based moire heterostructures [1]; (2) a band-folding-induced band inversion mechanism for topological minibands in two types of semiconducting models, namely the Rashba model and the Bernevig Hughes-Zhang (BHZ) model with moiré superlattice potentials[2]; (3) a topological heavy-fermion description for topological flat minibands in moiré BHZ model. A general theory based on band representations in the morié Brillouin zone is also developed for identifying topological minibands for different space groups.

[1] Yang K, Xu Z, Feng Y, Schindler F, Xu Y, Bi Z, Bernevig BA, Tang P, **Liu CX**. Topological minibands and interaction driven quantum anomalous Hall state in topological insulator based moiré heterostructures. Nature communications. 2024 Mar 26;15(1):2670.

[2] Yang K, Liu Y, Schindler F, **Liu CX**. Engineering Miniband Topology via Band-Folding in Moir\'e Superlattice Materials. arXiv preprint arXiv:2405.13145. 2024 May 21.