Fractionalization of High-Chern Insulators

Xiaobo Lu

School of Physics, Peking University

Email: xiaobolu@pku.edu.cn

The realization of moiré flatbands in graphene superlattices has unlocked a new paradigm for exploring strongly correlated topological states in the absence of an external magnetic field. In this talk, we present recent breakthroughs in engineering quantum anomalous Hall (QAH) effects and fractional Chern insulators (FCIs) within highly tunable crystalline flatband systems, with a specific focus on the 2+4 (Bernal bilayer on rhombohedral tetralayer) and 3+3 (twisted double rhombohedral trilayer) graphene architectures.

By continuously tuning the isospin configurations via twist angles and displacement fields, we demonstrate programmable integer QAH insulators with a high Chern number of C=3 at moiré filling ν=1 in the 3+3 system. Extending this framework to the 2+4 moiré platform, we discover an unprecedented richness of QAH insulators with Chern numbers ranging from C=1 to 7. Most remarkably, this system hosts an exotic fractional high-Chern insulator with C=7/3 around ν=2/3, expanding the understanding of fractionally charged excitations beyond traditional Landau level bases or Jain sequences.