Contribution ID: **10** Type: **not specified**

Microscopic theory of geometric excitations in strongly-correlated topological Chern bands

Monday 1 December 2025 10:40 (50 minutes)

We introduce a microscopic paradigm for geometric excitations called the graviton modes in Landau levels, and extend such studies to fractional Chern insulator (FCI) phases in moiré Chern bands. Strikingly, we identify an emergent guiding-center rotational symmetry in the FCI ground states and graviton modes, yet this symmetry is completely absent in the excitation continuum, leading to drastically shorter graviton lifetimes than in Landau levels. We develop a microscopic model to explain this phenomenon. Furthermore, we propose experimental tuning strategies for the detection of graviton modes in moiré materials as a new platform for probing geometric excitations in 2D quantum materials. We will also talk about the generalization of geometric excitations to higher spins.

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