Poster abstract for: Topology, Symmetry, and Interactions in Crystals: Emerging Concepts and Unifying Themes

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Moiŕ e alchemy: artificial atoms, Wigner molecules, and emergent Kagome lattice

Semiconductor moiré superlattices comprise an array of artificial atoms and provide a highly tunable platform for exploring novel electronic phases. We introduce a theoretical framework for studying moiré quantum matter that treats intra-moiré-atom interactions exactly and is controlled in the limit of large moiré period. We reveal an abundance of new physics arising from strong electron interactions when there are multiple electrons within a moiré unit cell. In particular, at filling factor n = 3, the Coulomb interaction within each three-electron moiré atom leads to a three- lobed “Wigner molecule”. When their size is comparable to the moiré period, the Wigner molecules form an emergent Kagome lattice. Our work identifies two universal length scales characterizing the kinetic and interaction energies in moiré materials and demonstrates a rich phase diagram due to their interplay.