

## Spontaneous Symmetry Breaking in Twisted Trilayer Graphene

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In this talk, I will present our recent work on structural phase diagram in twisted trilayer graphene (TTG). Interlayer and intralayer interactions between two interfaces in TTG transform this moiré-of-moiré lattice into an intricate network of domain structures at small twist angles, which can harbor exotic electronic behaviors. I will present a complete structural phase diagram of TTG with atomic scale lattice reconstruction. With a new interatomic potential simulation, I will show that a cornucopia of large-scale moiré lattices, ranging from triangular, kagome, and a corner-shared hexagram-shaped domain pattern, are present. For small twist angles below  $0.1^\circ$ , all domains are bounded by a network of two-dimensional domain wall lattices. In particular, in the limit of small twist angles, the competition between interlayer stacking energy and the formation of discommensurate domain walls leads to unique spontaneous symmetry breaking structures with nematic orders, suggesting the pivotal role of long-range interactions across entire layers. The diverse tessellation of distinct domains, whose topological network can be tuned by the adjustment of the twist angles, establishes TTG as a platform for exploring the interplay between emerging quantum properties and controllable nontrivial lattices.