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Nearly flat moire bands in graphene based twisted Dirac materials

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Twisted bilayer graphene is gaining a renewed boost of interest after experimental observation of superconductivity associated with the narrow bandwidth ‘flatbands’ attainable at appropriate twist angles and pressure tunable interlayer coupling. The relative enhancement of Coulomb interactions by the reduction in the kinetic energy through moire patterns is a new pathway for exploring correlation physics in compositionally simple materials. In this talk I will present efforts from our research group to elucidate the electronic structure of twisted few layer graphene in search for the optimum conditions of the onset of isolated nearly flat bands by analyzing the electronic structure of twisted gapless and gapped Dirac materials for various combinations of graphene and hexagonal boron nitride layers. We will pay particular attention to the properties of N-chiral rhombohedral few layer graphene moire systems where the bandwidth can be controlled through external electric fields and where narrow bandwidths are achievable in a wider range of twist angles than in twisted bilayer graphene. Our study shows that flatbands can be expected in a wide range of 2D Dirac materials parameter space, which is facilitated by the presence of intrinsic band gaps in the constituent materials. The avoided crossing of the bands in k-space give rise to well defined valley Chern numbers that can impact the character of the ground-state Hall conductivity depending on the specific configuration of the ground states.