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Mapping flavor polarization and competing Chern insulators in twisted bilayer graphene

Abstract: Combining two-dimensional crystalline materials into stacked heterostructures offers a powerful and versatile approach to tailor electronic behavior. In particular, the relative twist angle between layers serves as a novel control knob unique to such systems. Combining materials with similar lattice constants at relatively low twist angle produces a moiré superlattice potential that can dramatically modify the low-energy band structure and produce flat electronic bands that support correlated states and even nontrivial topology. The archetypal example is magic-angle twisted bilayer graphene (tBLG), whose rich phenomenology is still expanding. In this talk, I will describe local electronic compressibility measurements of tBLG conducted with a scanning single-electron transistor. We observe a delicate competition between states with different spin/valley flavor degeneracy as well as surprising sequences of correlated Chern insulating states. The favored ground states depend on density, perpendicular magnetic field, and local microscopic details. I will discuss our results in the context of possible symmetry breaking terms and polarization of the quantum degrees of freedom.

Bio: Ben Feldman is an Assistant Professor of Physics at Stanford University and is affiliated with the Geballe Laboratory for Advanced Materials and SLAC National Accelerator Laboratory. He started at Stanford in 2018 following a Dicke postdoctoral fellowship at Princeton University in the lab of Prof. Ali Yazdani. He earned his Ph.D. from Harvard University in 2013 working with Prof. Amir Yacoby. Research in the Feldman lab is focused on emergent strongly correlated and topological states, especially in 2D quantum materials. We use a mixture of cryogenic electronic transport, scanned probe microscopy, and capacitive sensing to realize, study, and control these novel phases.