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Correlated states in twisted bilayer WSe_2

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Artificial moiré superlattices have emerged as a new platform for realizing and manipulating correlated electron phenomena. Because the Coulomb interaction energy is comparable to the bandwidth in the narrow electron bands formed by the superlattices, electron interactions may induce new quantum phases. In twisted graphene-based systems, such flat bands lead to correlated insulator, superconducting, and topological states. Unlike graphene, which has extremely mobile Dirac electrons, semiconductor TMDs have a large effective mass that greatly enhances interaction effects and therefore display correlated states in a broad range of twist angles. In this talk, I will discuss how we utilized transport measurements to investigate quantum phases in the twist bilayer WSe_2. I will demonstrate that correlated states can be observed in this system with twist angles ranging from 4 to 5.1 degree. A correlated insulator that is tunable by both the twist angle and the displacement field emerges at half-band filling of the moiré subband. We further characterize the displacement field driven metal-insulator transitions and the metallic phase in twisted WSe_2. The metal-insulator transition is shown to be continuous as a function of density and displacement field. At low temperatures, the resistivity at the metal-insulator border exhibits strange metal behavior, with dissipation comparable to the Planckian limit. The existence of strong quantum fluctuations in the insulating phase is shown by an examination of the residual resistivity. These findings establish twisted WSe_2 as a unique platform for investigating correlated states and metal-insulator quantum phase transitions on a triangular lattice.