Magic continuum in twisted bilayer WSe2: Mott state and superconductivity

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Emergent quantum phases driven by electronic interactions can manifest in materials with narrowly dispersing, i.e. “flat", energy bands. Recently, flat bands have been realized in a variety of graphene-based heterostructures using the tuning parameters of twist angle, layer stacking and pressure, and resulting in correlated insulator and superconducting states. Here we report the experimental observation of similar correlated phenomena in twisted bilayer tungsten diselenide ($tWSe_2$), a semiconducting transition metal dichalcogenide (TMD). Unlike twisted bilayer graphene where the flat band appears only within a narrow range around a “magic angle", we observe correlated states over a continuum of angles, spanning 4° to 5.1°. Hall measurements supported by ab initio calculations suggest that the strength of the insulator is driven by the density of states at half filling, consistent with a 2D Hubbard model in a regime of moderate interactions. At 5.1° twist, we observe evidence of superconductivity upon doping away from half filling, reaching zero resistivity around 3 K. Our results establish twisted bilayer TMDs as a model system to study interaction-driven phenomena in flat bands with dynamically tunable interactions. Reference: arXiV: 1910.12147