Quantum anomalous Hall effects in twisted 2D semiconductors

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In twisted homobilayer semiconductors, quantum geometric properties of electrons can arise from the layer pseudospin when twisting introduces its spatial textures. In small angle twisted TMDs, real-space Berry curvature from the moire-patterned layer pseudospin texture realizes an effective magnetic flux [1] that underlies the emergence of quantum anomalous Hall effects recently observed in twisted MoTe2. The gate tunable ferromagnetic QAH observed at filling factor 1 further implies the existence of an antiferromagnetic orbital Chern insulator at filling factor 2, with the sign of Chern number electrically switchable at zero magnetic field [2]. These FM and AFM QAH states in twisted TMDs homobilayer moiré feature an intrinsic dipole Hall effect, which leads to a novel magnetoelectricity and allows contact-free detection of the topological transitions to QAH states [3]. I will also discuss a variant of the fluxed three-orbital tight-binding model proposed in Ref. [1] that describes a semimetal at integer filling, where DMRG calculations reveal fractional QAH phases at fractional fillings of its gapless flat band [4].

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References

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