Seminar announcement

Tuesday, July 8, 2025
1:30 pm
WSI, Seminar room S 101
Exclusively in person

“Optical control of correlated magnetism in moiré materials”

Understanding and controlling strongly correlated many-body spin systems is one of the key challenges in modern condensed matter physics. Among the most promising experimental platforms for these explorations are semiconducting moiré materials (SMMs), which consist of two twisted or lattice-mismatched transition metal dichalcogenide (TMD) monolayers. Owing to their spin-valley-selective optical selection rules and the possibility of incorporating them into charge-tunable devices, SMMs uniquely enable direct optical access to the spin degree of freedom of correlated electrons, whose density can be controlled in-situ using transparent graphene gates. In this talk, I will review our recent ultra-low-temperature magneto-optical investigations of collective electronic magnetism in two different types of SMMs. In the first part, I will focus on angle-aligned, AA-stacked MoSe2/WS2 heterobilayers, where the large detuning between conduction band edges suppresses interlayer hybridization, making this system a realization of an extended Fermi-Hubbard model. I will demonstrate that magnetism of electrons in this SMM can be driven not by exchange interactions, but by the minimization of doublon kinetic energy via the Nagaoka mechanism. In the second part of the talk, I will discuss twisted AA-stacked MoTe2 homobilayers, where strong interlayer hybridization of hole orbitals gives rise to flat topological valence bands that support robust ferromagnetic metals as well as fractional and integer Chern insulators at various moiré lattice filling factors. I will present our recent results demonstrating that the spin state of these topological many-body magnetic phases can be controlled with light, paving the way for ultrafast manipulation of the topological order parameter.

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