Many-body effects on exciton phenomena in 2D semiconductors

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Excited-state processes involving excitons - Coulomb-bound electron-hole pairs - are essential for emerging applications in functional materials, from energy conversion to quantum information science. The associated exciton generation and relaxation mechanisms are often coupled to quantum selection rules, stemming from the underlying material structure. In this talk, I will discuss the relation between exciton evolution and structural modifications in 2D transition metal dichalcogenides. In particular, the introduction of atomic defects and the composition of layered heterostructures offer controllable design pathways in these materials. Such modifications were shown to induce long-lived and coherent excited states that are tunable at the atomistic level through spatial localization and spin polarization. I will present our bandstructure approach to compute the associated exciton creation and interaction dynamics as a function of the underlying structure and discuss the importance of many-body effects to realize excited-state relaxation mechanisms, lifetimes and decoherence processes.

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