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Optical and magneto-optical properties of atomically thin transition metal dichalcogenides

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Recent advances in the development of atomically thin layers of van der Waals (vdW) bonded solids have opened up new possibilities for the exploration of two-dimensional (2D) physics as well as for materials for applications. Among them, semiconductor transition metal dichalcogenides have been shown to possess direct bandgaps in the near-infrared to the visible region in the monolayer limit, a property well suited for photonics and optoelectronics applications. This property is also widely tunable by doping, external fields and environmental effects, owing to the materials' atomic thickness. By stacking 2D vdW materials layer-by-layer, we exploit a vdW heterostructure device platform to improve the quality of atomically thin semiconductor transition metal dichalcogenides and to achieve independent control of the doping density and electric field in them. In this talk, we will discuss our recent studies on the doping-dependent optical properties and their dynamics, and the observation of a unique Landau level structure under a magnetic field in 2D WSe2 enabled by the heterostructure devices.