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Electrons, holes, and excitons in monolayer semiconductors: Magneto-optical studies of polarization dynamics and dielectric screening[1]

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The burgeoning interest in atomically thin semiconductors such as MoS_2 and WSe_2 derives in part from the spin-valley locking of resident carriers in n- or p-type material (for the development of notional spin- and/or valleytronic devices) and also from the strong light-matter coupling of tightly bound excitons (for optoelectronics applications). This talk discusses two recent magneto-optical studies that address how these intrinsic properties of electrons, holes, and excitons in 2D semiconductors can be measured and controlled in real devices. In the first study, the spin and valley dynamics of both resident electrons *and* resident holes are measured and tuned in gated single crystals of monolayer WSe_2, using time-resolved Kerr rotation spectroscopy and low magnetic fields [1,2]. Very different relaxation dynamics are observed in the electron- versus hole-doped regime, supporting a picture of robust spin-valley locking in the valence band. In the second study, broadband absorption and very large pulsed magnetic fields to 65T are used to directly reveal how the size and binding energy of 2D excitons are significantly affected by the surrounding dielectric environment [3] – of particular relevance to future van der Waals heterostructures and devices because excitons in 2D semiconductors necessarily reside close to an interface or surface. [1] P. Dey *et al., submitted*. [2] L. Yang *et al., Nature Physics* **11**, 830 (2015). [3] A.V. Stier *et al., Nano Letters* **16**, 7054 (2016).

[1]In collaboration with P. Dey, A.V. Stier & L. Yang (NHMFL), C. Robert, B. Urbaszek & X. Marie (INSA-Toulouse), N.P. Wilson & X. Xu (U. Washington).