

Colloquium Notice

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Magneto-optical spectroscopy of atomically-thin semiconductors using pulsed magnetic fields to 65 Tesla

In bulk and quantum-confined semiconductors, magneto-optical studies have historically played an essential role in determining the fundamental parameters of excitons (size, binding energy, spin, dimensionality and so on). Due to heavy band masses and large exciton binding energies in the newly discovered class of 2D semiconductors, such as monolayer WSe₂ or MoS₂, low-magnetic field studies have to date not revealed the majority of these properties.

In this talk, I will describe our results on low-temperature, circularly polarized magneto-optical spectroscopy on atomically-thin semiconductors in pulsed magnetic fields to 65 Tesla [1, 2].

After a brief introduction of the field of 2D semiconductors, I will present our results on the valley Zeeman splitting of both the A and the B excitons in WS₂. We find effective valley g -factors = -4.0 for *both* excitons. This unexpected and surprising result suggests that the valley Zeeman effect in these 2D semiconductors originates primarily from the atomic orbital magnetic moment *alone* - that is, the much-discussed Berry curvature in TMDs, appears to have minimal influence [1].

More importantly, the use of large magnetic fields allowed the first observation of the small quadratic diamagnetic shift of excitons in these materials. Diamagnetic shifts provide a direct experimental measure of the exciton size, and I will discuss how we can use this parameter to estimate the large exciton binding energies [1]. Lastly, I will discuss how we can tune the exciton size, and therefore the binding energy, in 2D materials by tuning the dielectric screening of the environment [2].

This work highlights how the dielectric screening of the environment influences 2D excitons and therefore aids in the smart design of novel optoelectronic devices that exploit the unique physics of van der Waals heterostructures.

[1] A. V. Stier *et al.*, *Nat. Comm.* **7**, 10643 (2016).

[2] A. V. Stier *et al.*, *Nano Lett.* **16**, 7054 (2016)

Wednesday

March 8, 2017

Starts at 12:15 PM

Coffee at 12:00 PM

Physics Conference Room, SB B326

