Spin, Charge, and Phonon Coupling Effects in a 2D Magnet

Xiaodong Xu
Department of Physics, Department of Materials Science and Engineering,
University of Washington, Seattle
xuxd@uw.edu

The coupling between spin, charge, and lattice degrees of freedom plays an important role in a wide range of fundamental phenomena. 2D magnets is an emerging platform for studying these coupling effects. In this talk, I will present such an example in a van der Waals zigzag antiferromagnetic insulator NiPS3. We observe an exciton photoluminescence with a narrow linewidth of ~350 μeV with near unity linear polarization. In addition, the optical reflection exhibits strong linear dichroism (LD) over a broad spectral range. The optical anisotropy axes of LD and of photoluminescence are locked to the zigzag direction. Their temperature dependence is also reminiscent of the in-plane magnetic susceptibility anisotropy. Our results suggest that LD and photoluminescence probes the symmetry breaking magnetic order parameter of 2D magnetic materials. Furthermore, we observe over ten exciton-A_{1g} phonon bound states on the high energy side of the exciton resonance, which we interpret as signs of a strong modulation of the ligand-to-metal charge transfer energy by electron-lattice interactions. Our work establishes NiPS3 as a 2D platform for exploring magneto-exciton physics with strong correlations.