Xiaodong Xu
Department of Physics, Department of Materials Science and Engineering, University of Washington, Seattle, WA, USA

xiaodongx@gmail.com

Two Dimensional Magnets

The recent discovery of 2D magnets enables new ways to study low dimensional magnetism by harnessing the unique features of atomically thin materials. In this talk, I will present two examples. The first one is on the demonstration of stacking order dependent magnetism in bilayer CrI_3 via second harmonic generation measurements. Using hydrostatic pressure, we realized tuning of its magnetic order via changing the stacking arrangement. We find that the interlayer magnetic coupling can be more than doubled by hydrostatic pressure. In bilayer CrI_3, pressure induces a transition from layered antiferromagnetic to ferromagnetic phases. In trilayer CrI_3, pressure can create coexisting domains of three phases, one ferromagnetic and two distinct antiferromagnetic. The second example is on the demonstration of a new magneto-optical effect, namely, the tuning of inelastically scattered light through symmetry control in CrI_3. In monolayers, we found an extraordinarily large magneto-optical Raman effect from an A_{1g} phonon mode due to the emergence of ferromagnetic order. The linearly polarized, inelastically scattered light rotates by ~40º, more than two orders of magnitude larger than the rotation from MOKE under the same experimental conditions. In CrI_3 bilayers, we show that the same A_{1g} phonon mode becomes Davydov-split into two modes of opposite parity, exhibiting divergent selection rules that depend on inversion symmetry and the underlying magnetic order. By switching between the antiferromagnetic states and the fully spin-polarized states with applied magnetic and electric fields, we demonstrate the magnetoelectrical control over these selection rules. This manifests in the activation/suppression of Raman activity for the odd-parity phonon mode and the magneto-optical rotation of scattered light from the even-parity phonon mode.