Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Valley- and spin-polarized Landau levels in monolayer WSe2 ZEFANG WANG, JIE SHAN, KIN FAI MAK, Department of Physics, Pennsylvania State University — Electrons in monolayer transition metal dichalcogenides (TMDs) are characterized by valley and spin quantum degrees of freedom, making it possible to explore new physical phenomena and applications in electronics and optoelectronics. Under a perpendicular magnetic field, theoretical studies have predicted the formation of discrete Landau Levels (LLs) in monolayer TMDs that are distinct from the case of two-dimensional (2D) electrons both in conventional semiconductor quantum wells and in graphene. Because of the broken sublattice symmetry and of the valley-contrasting Berry curvature effect, the zero-energy LLs at the K and K' valleys in monolayer TMDs are split by the material's bandgap. The strong spin-orbit interactions further spin-polarize the LLs at each valley. However, this unique LL structure has not been observed experimentally. In this talk we report the observation of fully valley- and spin-polarized LLs in high-quality WSe2 monolayers achieved by exploiting a van der Waals heterostructure device platform. We applied handedness-resolved optical reflection spectroscopy to probe the inter-LL transitions at individual valleys and derived the LL structure. Our results open up possibilities for studies of unconventional LL physics and the quantum Hall effect in a 2D semiconductor.

Zefang Wang
Department of Physics, Pennsylvania State University

Date submitted: 11 Nov 2016 Electronic form version 1.4