Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Electrical tunability and optical control of valley and spin in WSe2[1] AARON JONES, University of Washington, HONGYI YU, University of Hong Kong, NIRMAL GHIMIRE, Oak Ridge National Laboratory, BO ZHAO, SANFENG WU, GRANT AIVAZIAN, JASON ROSS, University of Washington, GUIBIN LIU, University of Hong Kong, JIAQIANG YAN, DAVID MANDRUS, Oak Ridge National Laboratory, WANG YAO, University of Hong Kong, DI XIAO, Carnegie Mellon University, XIAODONG XU, University of Washington — Monolayer group VI transition metal dichalcogenides have enormous potential for use in nano- and optoelectronic applications due to their reduced dimensionality and direct bandgap in the visible wavelength range. Their hexagonal structure is graphene-like, but with strong spin-orbit coupling effects. The interesting coupled spin-valley physics has been investigated both theoretically and experimentally based on the single particle picture. Here we investigate the physical properties of valley excitons in monolayer field effect transistor devices via photoluminescence measurements. By tuning the chemical potential to control exciton species, we are able to investigate the optical selection rules, photo-excitation energy dependence, and temperature dependence of individual excitons. These studies reveal the fine structures of valley excitons due to the electron-electron interactions, electron-phonon interactions, and coupled spin-valley degrees of freedom, which are important for the potential application of valleytronics/spintronics based on monolayer semiconductors.

[1]We acknowledge support from NSF Early Career Award & GRFP.

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Date submitted: 13 Nov 2012 Electronic form version 1.4