MAR16-2015-006038

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Long-lived Spin Relaxation and Spin Coherence of Electrons in Monolayer MoS_2[1]

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Monolayer MoS_2 and related transition metal dichalcogenides (TMDs) are direct-gap semiconductors in which strong spin-orbit coupling and a lack of structural inversion symmetry give rise to new coupled spin–valley physics. Although robust spin and valley degrees of freedom have been inferred from polarized photoluminescence (PL) studies of *excitons*, PL timescales are necessarily constrained by short (3–100 ps) electron–hole recombination. Direct probes of spin/valley dynamics of resident carriers in electron (or hole)-doped TMDs, which may persist long after recombination ceases, are still at an early stage. Here we directly measure the coupled spin-valley dynamics of *resident* electrons in n-type monolayer MoS_2 using optical Kerr-rotation spectroscopy [1], and reveal very long spin lifetimes exceeding 3ns at 5K (orders of magnitude longer than typical exciton lifetimes). In contrast with conventional III-V or II-VI semiconductors, spin relaxation accelerates rapidly in small transverse magnetic fields. This suggests a novel mechanism of electron spin dephasing in monolayer TMDs, driven by rapidly-fluctuating internal spin-orbit fields due to fast intervalley scattering. Additionally, a small but very long-lived oscillatory signal is observed, indicating spin coherence of localized states [2]. These studies provide direct insight into the physics underpinning the spin and valley dynamics of electrons in monolayer TMDs. [1] L. Yang *et al.*, *Nature Physics* **11**, 830 (2015). [2] L. Yang *et al.*, *submitted.*

[1]In collaboration with S.A. Crooker N.A. Sinitsyn (Los Alamos), W. Chen, J. Yuan, J. Zhang J. Lou (Rice University), K.M. McCreary B.T. Jonker (Naval Research Lab), and supported by the Los Alamos LDRD program.