Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

**Coherent Electronic Coupling in Monolayer $MoSe_2$** GALAN MOODY[1], AKSHAY SINGH, University of Texas-Austin, SANFENG WU, University of Washington, YANWEN WU, University of Texas-Austin; University of South Carolina, NIRMAL GHIMIRE, JIAQIANG YAN, DAVID MANDRUS, University of Tennessee; Oak Ridge National Laboratory, XIAODONG XU, University of Washington, XIAOQIN LI, University of Texas-Austin — Monolayer transition metal dichalcogenides (TMDs) have emerged as an interesting class of two-dimensional materials due to their unique optical properties, such as a crossover from an indirect-to-direct bandgap as well as valley-specific optical selection rules. A striking feature in the linear optical spectra of TMDs is pronounced neutral and charged excitons (trions), with significantly larger binding energies than conventional semiconductors due to reduced screening. Using ultrafast two-color pump-probe spectroscopy, we demonstrate that Coulomb interactions responsible for the large binding energies in monolayer $MoSe_2$ also lead to strong coherent coupling between excitons and trions. Signatures for coherent coupling appear as isolated cross-peaks in a 2D spectrum obtained by tuning the pump and probe wavelengths through the resonances. While incoherent population transfer may partially contribute to one of the peaks, density matrix calculations reveal that the unique peak lineshapes arise from coherent exciton-trion many-body interactions, whose strength is significantly larger compared to conventional semiconductor quantum wells. Strong exciton-trion coherent coupling demonstrated here makes TMDs an excellent platform for future coherent opto-electronic devices.

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Date submitted: 05 Jan 2014 Electronic form version 1.4