Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Ultrafast Manipulation of the Valley Coherence in Monolayer WSe_2 ZILIANG YE, DEZHENG SUN, TONY HEINZ, Departments of Applied Physics and Photon Science, Stanford University — The valley degree of freedom in solids has been proposed as a pseudospin carrier for the future quantum electronics. Valley polarization has been created in transition metal dichalcogenide monolayers using circularly polarized light and the existence of coherence in the valley exciton pseudospin has been experimentally demonstrated[1]. The degeneracy of the valley degeneracy has recently been lifted both by the application of magnetic fields and dynamically by the optical Stark effect with circularly polarized light[2−3]. Here we demonstrate the all-optical manipulation of valley exciton coherence, i.e., of the valley exciton pseudospin, by the optical Stark effect. Using below-bandgap circularly polarized light, we rotate the valley exciton pseudospin on the femtosecond time scale. Both the direction and speed of the rotation can be optically controlled by tuning the dynamic phase of excitons in opposite valleys. In addition, by varying the time delay between the excitation and control pulses, we probe the lifetime of the intervalley coherence in monolayer WSe_2.

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Date submitted: 03 Nov 2015 Electronic form version 1.4