MAR17-2016-020124

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Control of Exciton Valley Coherence in Transition Metal Dichalcogenide Monolayers[1]

GANG WANG, CNRS-Toulouse University

Current research on Transition Metal Dichalcogenide (TMD) Monolayers is stimulated by their strong light-matter interaction and the possibility to use the valley index in addition to spin as an information carrier. The direct gap interband transitions in TMD monolayers are governed by chiral optical selection rules. Determined by laser helicity, optical transitions in either the K+ or K- valley in momentum space are induced. Very recently the optical generation of valley polarization and valley coherence (coherent superposition of valley states) have been reported. In this work we go a step further by discussing the coherent manipulation of valley states. Linearly polarized laser excitation prepares a coherent superposition of valley states. We demonstrate the control of the exciton valley coherence in monolayer WSe2 by tuning the applied magnetic field perpendicular to the monolayer plane [1]. The induced valley Zeeman splitting between K+ and K- results in a change of the oscillation frequency of the superposition of the valley states, which corresponds to a rotation of the exciton valley pseudo-spin. We show rotation of this coherent superposition of valley states by angles as large as 30 degrees in applied fields up to 9T and discuss valley coherence in other TMD monolayer materials. This exciton valley coherence control on ps time scale could be an important step towards complete control of qubits based on the valley degree of freedom. [1] G. Wang et al, Phys. Rev. Lett. 117, 187401 (2016).

[1]In collaboration with X. Marie, T. Amand, C. Robert, F. Cadiz, P. Renucci, B. Urbaszek (Universit de Toulouse, INSA-CNRS-UPS, LPCNO, France), B. L. Liu (Institute of Physics, Chinese Academy of Sciences, China) and we acknowledge ERC Grant No. 306719.