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Long valley lifetime of free carriers in monolayer WSe2 YAN TENGFEI, XIAODONG CUI, University of Hong Kong — Monolayer transition metal dichalcogenids (TMDs) feature valley degree of freedom, giant spin-orbit coupling and spin-valley locking. These exotic natures stimulate efforts of exploring the potential applications in conceptual spintronics, valleytronics and quantum computing. Among all the exotic directions, a long lifetime of spin and/or valley polarization is critical. The present valley dynamics studies concentrate on the band edge excitons which predominates the optical response due to the enhanced Coulomb interaction in two dimensions. The valley lifetime of free carriers remains in ambiguity. In this work, we use time-resolved Kerr rotation spectroscopy to probe the valley dynamics of excitons and free carriers in monolayer tungsten diselinide. The valley lifetime of free carriers is found around 2 ns at 70 K, about 3 orders of magnitude longer than the excitons of about 2 ps. The extended valley lifetime of free carriers evidences that exchange interaction dominates the valley relaxation in optical excitation. The pump-probe spectroscopy also reveals the exciton binding energy of 0.60 eV in monolayer WSe_2.

Yan Tengfei
Univeristy of Hong Kong

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