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Doping-Dependent Study of Valley Relaxation Dynamics in Monolayer Transition Metal Dichalcogenides YI-HSIN CHIU, ZEFANG WANG, KIN FAI MAK, JIE SHAN, Pennsylvania State Univ — Due to inherent broken inversion symmetry and the resulting spin-valley coupling, monolayer transition metal dichalcogenides (TMDs) hold great promise for exploiting valley-dependent physics and applications in electronics and optoelectronics. Here, we report an investigation of the valley relaxation dynamics of excitons in monolayer WSe2. Both the electron- and hole-doped regime can be readily accessed with a systematic variation of doping density in dual gated field-effect transistors of monolayer WSe2. Exciton valley polarization is probed by time-resolved photoluminescence measurements at varying temperatures, revealing intriguing dynamics with distinct depolarization behaviors in the two doping regimes. These observations highlight the importance of the electronic structure in the valley relaxation dynamics and shed light on the effect of valley-dependent electron-hole exchange and many-body interactions in atomically thin TMDs.

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