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Valley relaxation dynamics in monolayer semiconductors studied by transient absorption and multidimensional spectroscopies KENAN GUNDOGDU, CONG MAI, ANDREW BARRETTE, YIFEI YU, LINYOU CAO, YURIY SEMENOV, KI WOOK KIM, North Carolina State Univ — Single layer transition metal dichalcogenides are 2D semiconducting systems with unique electronic band structure. Two-valley energy bands along with strong spin-orbital coupling lead to valley dependent career spin polarization, which is the basis for recently proposed valleytronic applications. These systems also exhibit unusually strong many body affects, such as strong exciton and trion binding, due to reduced dielectric screening of Coulomb interactions. Recently observed large photoluminescence helicity suggests beyond ns hole spin and valley lifetimes. But there is not much known about the impact of strong many particle correlations on spin and valley polarization dynamics. Here we report direct measurements of ultrafast valley specific relaxation dynamics in single layer MoS_2. We found that excitonic many body interactions significantly contribute to the relaxation process.. Biexciton formation reveals hole valley/spin relaxation time. Our results suggest that initial fast intervalley electron scattering and electron spin relaxation leads to loss of valley polarization for holes through an electron-hole exchange mechanism.

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