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Observation of Rapid Exciton–Exciton Annihilation in Monolayer Molybdenum Disulfide DEZHENG SUN, Departments of Physics and Electrical Engineering, Columbia University, YI RAO, Temple University, GEORG REIDER, Photonics Institute, TU Wien, GUGANG CHEN, Honda Research Institute USA, Inc, YUMENG YOU, Departments of Physics and Electrical Engineering, Columbia University,, LOUIS BRÉZIN, Laboratoire d'Optique Appliquée, ENSTA, CNRS, Ecole Polytechnique, AVETIK HARUTYUNYAN, Honda Research Institute USA, Inc., TONY HEINZ, Departments of Physics and Electrical Engineering, Columbia University — In this paper, we present ultraist pump-probe spectroscopy results for monolayer MoS2 crystals in which we explore exciton dynamics as a function of exciton density. After a femtosecond excitation pulse of near-resonant radiation to create A excitons, we have monitored the temporal evolution of the exciton density using a continuum probe pulse. We observe a decay rate as long as 100 ps for samples at room temperature and at relatively low exciton density. The decay rate increases strongly with increasing exciton density. We are able to fit the entire set of density-dependent exciton dynamics using a simple model in which the dominant decay channel is an exciton-exciton annihilation process. From these measurements, we infer an exciton-exciton annihilation rate of $(4.3 \pm 1.1) \times 10^2$ cm^2/s. We compare this rate with that observed in other nanostructured materials.

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