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Measurements of ultrafast luminescence dynamics in transition metal dichalcogenide monolayers CEDRIC ROBERT, GANG WANG, DELPHINE LAGARDE, ANDREA BALOCCHI, THIERRY AMAND, PIERRE RENUCCI, FABIAN CADIZ, BERNHARD URBASZEK, XAVIER MARIE, CNRS/INSA Toulouse — We report time resolved photoluminescence (PL) measurements using a synchro-scan streak camera system with sub-ps time resolution, the fastest detector currently available for PL. The strong electron-hole Coulomb interaction in monolayer (ML) transition metal dichalcogenides results in excitons with high binding energies and oscillator strength. Therefore very short intrinsic radiative lifetimes can be expected. Here measurements with few ps time resolution are crucial. In our experiment we excite the ML sample with a fs laser pulse in a cryostat (T=4300 K). In the model system ML MoSe2 we can separate spectrally the neutral and the charged exciton and perform detailed time-resolved PL studies on each complex. For the neutral exciton we resolve a PL emission time as short as 2ps, previous measurements were limited by the detector time-resolution. This short time depends on the experimental conditions such as temperature and applied external fields. We will discuss the different competing relaxation and recombination mechanisms, such as the intrinsic radiative recombination, the escape from the light cone through phonon scattering, the interplay between bright and dark exciton states and the possible transfer from the neutral to the charged exciton at lower energy.

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