Light-matter interactions in two-dimensional materials explored with coherent time-resolved spectroscopy

Denis Karaiskaj
Department of physics, University of South Florida, Tampa 33620, Florida

Monolayer two-dimensional transition metal dichalcogenide (TMDs) have generated excitement because of their interesting fundamental physical properties and promising applications on electronic and optoelectronic devices. The strong unscreened Coulomb interactions and the anisotropic dielectric environment in these materials lead to the formation of strongly bound excitons, trions, and biexcitons. Biexcitons in monolayer TMDs have unusually large binding energies and have been of interest for both fundamental studies and device applications. Furthermore, in magnetic fields the excitons in TMDs experience valley Zeeman splitting, which can be used to magnetically tune the polarization and coherence of the excitonic valley pseudospin. Coherent time-resolved experiments at magnetic fields up to 25 Tesla will be presented, providing new insights into these phenomena [1-2].

Up to now, most theoretical and experimental investigations of TMD structures have focused on the evolution of the bandgap and exciton binding, while changing the dielectric substrate or number of layers. Surprisingly, little or no attention has been paid to changes in the optical spectra of TMD multilayer structures due to light propagation effects and radiative coupling. Therefore, interesting results indicating radiative coupling will be presented [3].

[1] Dey *et al*., Phys. Rev. Lett. **116,** 127402 (2016)
[2] Stevens *et al*., Nat. Commun. **9**, 3720 (2018)
[3] Stevens *et al*., Optica 5, **749** (2018)