

Dynamics of Valley-Polarized Microcavity Exciton-Polaritons in a 2D Semiconductor

Nathaniel P. Stern

Yen-Jung Chen, Teodor K. Stanev, Jeff C. Cain, Vinayak Dravid

Northwestern University, Evanston, IL 60208, USA

n-stern@northwestern.edu

Coherent hybrid states of light and matter, exciton-polaritons, have been observed when monolayer transition metal dichalcogenides (TMDs) interact with photons in a microcavity [1]. Although exciton-polaritons have been studied for several decades in various semiconductors, one feature that sets monolayer TMDs apart from traditional semiconductors is the degenerate valley structure at the band gap that can be selectively excited with circularly polarized light. This valley degree of freedom available in monolayer TMDs allows these hybrid light-matter states to exhibit valley polarization as in a bare monolayer [2]. The influence of this valley structure on light-matter quasi-particle dynamics is not well understood. Here, I discuss measurements of valley-selective exciton-polaritons evidenced by circularly polarized photoluminescence from MoS₂ embedded inside a microcavity. I show that the strongly-coupled dynamics of these valley-sensitive hybrid light-matter quasiparticles is determined by the relative rates of exciton relaxation and intervalley scattering, which can be highly modified in on-resonant cavities, even persisting to room temperature due to the interaction with the microcavity photons. The dynamics of strongly and weakly coupled exciton-polaritons in MoS₂ microcavities are consistent with a cavity quantum electrodynamics model incorporating valley specificity. These experimental and model

results demonstrate that dynamics of valley pseudospin can be controlled by engineering light-matter interactions 2D TMD photonics.

References

- [1] X. Liu, T. Galfsky, Z. Sun, F. Xia, E. Lin, Y. Lee, S. Kena-Cohen, and V. M. Menon, *Nature Photonics*, 9 (2015), 30
- [2] Y.-J. Chen, T. K. Stanev, J. C. Cain, V. Dravid, and N. P. Stern. *CLEO: Science and Innovations* (2016) Stu3F

Figures

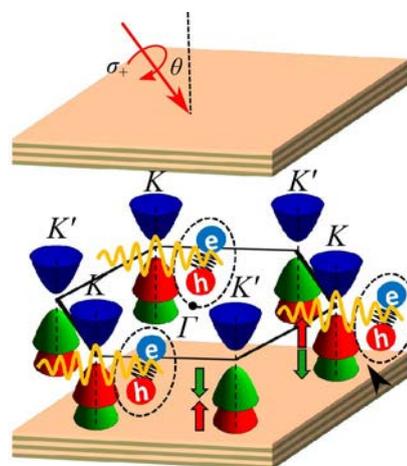


Figure 1: Schematic of valley-polarized exciton-polaritons in a 2D semiconductor embedded in a microcavity. A circularly-polarized pump excites only specific valleys, which couple strongly to the polarized microcavity photon mode, which is detected from luminescence.