MAR16-2015-000793

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Novel exciton systems in 2D TMD monolayers and heterobilayers[1]

HONGYI YU, Department of Physics and Center of Theoretical and Computational Physics, The University of Hong Kong

In this talk, two exciton systems in transition metal dichalcogenides (TMDs) monolayer and heterobilayer will be discussed. In TMD monolayers, the strong e-h Coulomb exchange interaction splits the exciton and trion dispersions into two branches with zero and finite gap, respectively [2] [3]. Each branch is a center-of-mass wave vector dependent coherent superposition of the two valleys, which leads to a valley-orbit coupling and possibly a trion valley Hall effect. The exchange interaction also eliminates the linear polarization of the negative trion PL emission [4]. In TMD heterobilayers with a type-II band alignment, the low energy exciton has an interlayer configuration with the e and h localized in opposite layers. Because of the inevitable twist or/and lattice mismatch between the two layers, the bright interlayer excitons are located at finite center-of-mass velocities with a six-fold degeneracy [5]. The corresponding photon emission is elliptically polarized, with the major axis locked to the direction of exciton velocity, and helicity determined by the valley indices of the e and h. Some experimental results on the interlayer excitons in the WSe_2-$MoSe_2$ heterobilayers will also be presented. The interlayer exciton exhibits a long lifetime as well as a long depolarization time, which facilitate the observation of a PL polarization ring pattern due to the valley dependent exciton-exciton interaction induced expansion [6].

[1]The works were supported by the Research Grant Council of Hong Kong (HKU17305914P, HKU705513P), the Croucher Foundation, and the HKU OYRA and ROP.

[2]H. Yu, G.-B. Liu, P. Gong, X. Xu, and W. Yao, Nat. Commun. **5**, 3876 (2014).
[3]H. Yu, X. Cui, X. Xu, and W. Yao, Natl Sci Rev **2**, 57 (2015).
[4]A. Jones, H. Yu, N. Ghimire, S. Wu, G. Aivazian, J. Ross, B. Zhao, J. Yan, D. Mandrus, D. Xiao, W. Yao, and X. Xu, Nature Nanotech. **8**, 634 (2013).
[5]H. Yu, Y. Wang, Q. Tong, X. Xu, and W. Yao, Phys. Rev. Lett. **115**, 187002 (2015).
[6]P. Rivera, K. L. Seyler, H. Yu, J. R. Schaibley, J. Yan, D. G. Mandrus, W. Yao, and X. Xu, to be published.