APCTP SEMINAR

Moiré excitons in 2D transition metal dichalcogenide heterostructures

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Online via ZOOM

Van der Waals heterostructures can be designed to confine electrons and holes in unique ways. One remarkable approach is to vertically stack two atomically thin layers of transition metal dichalcogenide (TMD) semiconductors. The relative twist or lattice mismatch between the two layers leads to moiré pattern formation, which modulates the electronic band structure according to the atomic registry. Single-particle wave packets can be trapped in the moiré- induced potential pockets with three-fold symmetry, leading to the formation of trapped interlayer excitons. This can create uniform high-density arrays of quantum emitters or topological bands whose properties can be manipulated by electric or strain fields. In this talk, I will explain photoluminescence emission of moiré confined excitons in MoSe2/WSe2 heterobilayer and heterotrilayer [1]. Polarization and magnetic-field dependence of moiré confined excitons will be shown. Furthermore, interesting properties of moiré excitons like antibunching, large Stark shift, and doping dependence will be presented [2,3]. Finally, correlated states, such as Mott insulating states and Wigner crystals, observed from moiré heterostructures will be presented.

[1] M. Brotons-Gisbert, H. Baek, A. Molina-Sánchez, A. Campbell, D. Scerri, D. White, K. Watanabe, T. Taniguchi, C. Bonato, and B. D. Gerardot, "Spin-layer locking of interlayer excitons trapped in moiré potentials", Nature Materials 19, 630 (2020)

[2] H. Baek, M. Brotons-Gisbert, Z. X. Koong, A. Campbell, M. Rambach, K. Watanabe, T. Taniguchi, and B. D. Gerardot, "Highly energy-tunable quantum light from moiré-trapped excitons", Science Advances 6, eaba8526 (2020)

[3] H. Baek, M. Brotons-Gisbert, A. Campbell, K. Watanabe, T. Taniguchi, B. D. Gerardot, "Optical read-out of Coulomb staircases in a moiré superlattice via trapped interlayer trions", Nature Nanotechnology, online published (2021)

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