Seminarankündigung

Dienstag, 6. März 2018
14:00 Uhr

ZNN, Seminarraum EG 0.001

"Optical spectroscopy of 2D semiconductors in pulsed magnetic fields to 65 Tesla"

In bulk and quantum-confined semiconductors, optical spectroscopy in high magnetic fields has historically played an essential role in determining the fundamental properties of excitons such as their mass, size, binding energy, dimensionality, and spin. In conventional semiconductors such as GaAs, which have light carrier masses and small exciton binding energies EB, magnetic fields of order 10T are typically sufficient to achieve the regime where magnetic (cyclotron) energies exceed EB. In marked contrast, in the new family of monolayer semiconductors such as MoS2, WSe2 or 2D Ruddlesden-Popper perovskites, carrier masses are heavier and EB is huge (hundreds of meV), requiring much larger magnetic fields of order 100 T to approach a similar regime [1,2,3].

In this talk, I will review our recent progress on optical transmission spectroscopy of laterally small (~µm) and atomically thin semiconductors in extremely large magnetic fields to 65 Tesla. This method allowed us to observe the diamagnetic shifts of the 1s – 4s Rydberg states of the neutral exciton in single WSe2 monolayers encapsulated in hBN [2], which allowed the unambiguous identification of those states, a quantitative and detailed comparison with leading theoretical models (Keldysh potential) and the first direct experimental measure of the exciton's reduced mass in a monolayer semiconductor. Finally I will highlight our combined zero field and high field spectroscopy of organic-inorganic 2D Ruddlesden Popper perovskites. We identify that strongly bound excitons are the fundamental optical excitations in this material class and map out the mass and unusual evolution of the binding energy as a function of the thickness of the perovskites layer. These studies aid our understanding of Coulomb interactions in 2D semiconductors and provide design principles for future devices based on these materials.

[1] A.V. Stier et al., Nature Commun. 7, 10643 (2016)
[2] A.V. Stier et al., Phys. Rev. Lett 120, 057405 (2018)
[3] J.C. Blancon, A.V. Stier et al., arXiv:1710.07653 (2017)

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