Eugene Wigner Colloquium

event of SFB 910

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“Quantum transport of excitons in transition metal dichalcogenide monolayers”

Atomically thin crystals based on transition metal dichalcogenides host robust excitons that demonstrate fascinating optical properties [1]. The excitons can propagate in the monolayer plane, which makes it possible to study the transport properties of excitons. Here we present the theory of exciton transport in transition metal dichalcogenide monolayers. We address three experimentally relevant situations:

1) Nonlinear exciton transport under the conditions of strong exciton-exciton interaction and exciton drag by non-equilibrium phonons [2,3].
2) Exciton spin/valley transport and exciton valley Hall effect resulting from the strong spin-orbit interaction in atomically thin semiconductors.
3) Quantum interference of excitons resulting in the weak localization effect, which results in the strong temperature dependence of the exciton diffusion coefficient.

Theoretical results are compared with the available experimental data.

[1] Gang Wang, Alexey Chernikov, Mikhail M. Glazov, Tony F. Heinz, Xavier Marie, Thierry Amand, and Bernhard Urbaszek, Colloquium: Excitons in atomically thin transition metal dichalcogenides, Rev. Mod. Phys. 90, 021001 (2018).
[2] Marvin Kulig, Jonas Zipfel, Philipp Nagler, Sofia Blanter, Christian Schueller, Tobias Korn, Nicola Paradiso, Mikhail M. Glazov, and Alexey Chernikov, Exciton Diffusion and Halo Effects in Monolayer Semiconductors, Phys. Rev. Lett. 120, 207401 (2018).
[3] M. M. Glazov, Phonon wind and drag of excitons in monolayer semiconductors, Phys. Rev. B 100, 045426 (2019).

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