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Allgemeines Physikalisches Kolloquium

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Online-Kolloquium

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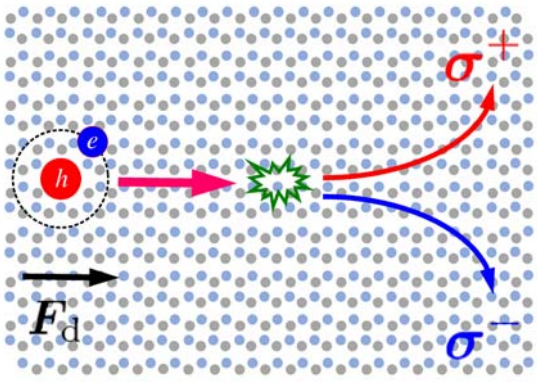
Quantum effects in optics and transport of excitons in atomically thin semiconductors

Two-dimensional (2D) semiconductor systems based on quantum wells have revolutionized modern electronics and optoelectronics. Recently, another class of stable 2D materials starting with graphene and transition metal dichalcogenides (TMDCs) such as MoS2 have revealed novel physics at the fundamental level offering unique functionalities relevant for future applications in 'valleytronics' and quantum technologies. Atomically thin TMDCs possess spectacular optical and transport properties. Strong Coulomb interaction binds electrons and holes in excitons: neutral quasi-particles with considerable (up to several hundreds of meV) binding energies [1]. I present a brief overview of the key quantum effects in excitonic transport and optical properties in my talk. Particularly, I will describe the main features of the band structure and excitonic properties of TMDC monolayers and then I will focus on two phenomena including the Valley Hall effect and the charged exciton-polarons. In this talk, I will emphasize the phenomena inherent to the atomically thin semiconductors.

References:
[1] Gang Wang, et al. Rev. Mod. Phys. 90, 021001 (2018).
[2] M. M. Glazov and L. E. Golub, et al. Phys. Rev. Lett. 125, 157403 (2020).
[3] A. Arora, et al. Phys. Rev. Lett. 123, 167401 (2019).
[4] K. Wagner, et al. arXiv:2007.05396 (2020).



Schematics of the VHE for excitons, with the black arrow F_d showing the drag force and arrows denoting the propagation directions of the excitons in the opposite valleys. The figure illustrates the skew scattering where the excitons are separated due to the asymmetric scattering by impurities or phonons

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