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SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

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Collective excitations, Moiré minibands and dense exciton ensembles in van der Waals stacks

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Two-dimensional (2D) materials are atomically thin crystals characterized by strong in-plane chemical bonds and weak van der Waals (vdW) coupling between adjacent layers allowing to assemble vdW stacks. We show that heterobilayers of transition-metal dichalcogenides such as $MoSe_2/WSe_2$ host dense ensembles of interlayer excitons potentially forming a coherent many-body state at low temperature [1-3]. Moreover, twisted homobilayers such as $tWSe_2$ are prone to the formation of moiré minibands. Both, the formation of moiré minibands as well as the potential landscape for interlayer excitons are significantly impacted by lattice reconstruction and lateral inhomogeneities due to twist variations and disorder. We demonstrate, that this (twist-)disorder can be accessed by lateral force microscopy and discuss their impact on optical properties. Collective electronic excitations in those atomically thin crystals can be accessed by means of low-temperature resonant inelastic light scattering (RILS) spectroscopy. RILS is a well-established powerful method to study low-dimensional interacting electronic systems [4] as well as (exotic) correlated phases as we recently demonstrated by the observation of chiral graviton modes in the fractional quantum Hall liquid [5]. In $tWSe_2$ bilayers, we access a series of RILS modes showing a peculiar dependence on twist angle and temperature that are interpreted as single-particle like collective inter-moiré-band excitations [6]. These observations allow to quantitatively probe the formation of a series of moiré-bands and demonstrate the potential to study correlated electron phases in twisted bilayers.

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[4] S. Das Sarma, and Daw-Wei Wang Phys. Rev. Lett. **83**, 816 (1999).
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Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

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