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Using dispersive medium to control excitons in 2D materials. ANDREY KLOTS, Vanderbilt University, KIRILL I. BOLOTIN, Vanderbilt University; Freie University — Excitons in 2D materials (2DMs) are known to be sensitive to the surrounding environment. This makes it possible to modify 2D excitons by depositing materials with controlled dielectric constant on top of 2DMs. This possibility becomes especially interesting if we consider materials with dielectric permittivity ε that depends both on wavevector k (this happens if the medium is spatially non-uniform) and frequency ω. Here, we develop platforms to control $\varepsilon(k,\omega)$ and explore resulting changes in light-matter interactions of 2DMs. To examine the effect of wavevector-dependent permittivity of the medium, we study absorption/photoluminescence of graphene and MoS_2 in the vicinity of highly non-uniform medium - an array of metal nanoparticles, 3-5 nm in diameter. In this case absorption of light can lead to creation of excitons with non-zero momentum. These dark states are not accessible via regular absorption spectroscopy. We study the case of frequency-dependent permittivity by surrounding MoS_2 by a highly-dispersive media (e.g. dielectric liquids, graphene and VO_2). We demonstrate non-trivial frequency-dependent renormalization of the quasiparticle bandgap and exciton binding energies.

Andrey Klots
Vanderbilt University

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