Physics Colloquium

Thursday

January 24

4:00 P.M.

Rm 118 NSH

Excitons in Flatland: Exploring and manipulating many-body effects on the optical excitations in quasi-2D materials

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Since the isolation of graphene in 2004, atomically-thin quasi-two-dimensional (quasi-2D) materials have proven to be an exciting platform for both applications in novel devices and exploring fundamental phenomena arising in low dimensions. This interesting low- dimensional behavior is a consequence of the combined effects of quantum confinement and stronger electron-electron correlations due to reduced screening. In this talk, I will discuss how the optical excitations (excitons) in quasi-2D materials, such as monolayer transition metal dichalcogenides and few-layer black phosphorus, differ from typical bulk materials. In particular, quasi-2D materials are host to a wide-variety of strongly-bound excitons with unusual excitation spectra and massless dispersion. The presence of these excitons can greatly enhance both linear and nonlinear response compared to bulk materials, making them ideal candidates for optoelectronics and energy applications. Moreover, due to enhanced correlations and environmental sensitivity, the electronic and optical properties of these materials can be easily tuned. I will discuss how substrate engineering, stacking of different layers, and the introduction or removal of defects can be used to tune the band gaps and optical selection rules in quasi-2D materials.

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