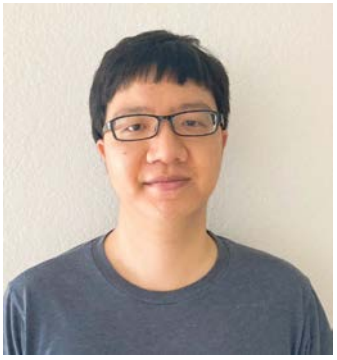
THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

COLLOQUIUM

Exploring Exotic Photoexcited Phenomena in 2D van der Waals Heterostructures

by



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Date: March 26, 2024 (Tuesday)
Time: 10:00 - 11:00 a.m.
Join ZOOM Meeting: https://bit.ly/3wBEWc0

ALL INTERESTED ARE WELCOME

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Abstract

Employing light to study intriguing phenomena or to induce and tune exotic phases of matter lies at the heart of condensed matter science and optoelectronic technologies. Recent developments in optical spectroscopies have provided rich experimental signatures of novel excited states and ultrafast photoexcited responses in 2D van der Waals (vdW) heterostructures; however, the nature of many of these phenomena remains to be fully explored. In this talk, I will discuss our two recent works in this direction, based on a newly-developed first-principles time-dependent interacting Green's function approach. First, I will demonstrate a new excitonic mechanism for the photoexcited interlayer exciton dynamics (and associated ultrafast optical responses) in transition metal dichalcogenide (TMD) vdW heterobilayers, which is conceptually different from the conventional single-particle picture. Strong excitonic couplings are discovered to be a main driving in the ultrafast exciton and optical dynamics. Second, I will show that the excitonic physics could also greatly enhance the nonlinear optical responses in vdW moiré superlattices, leading to a striking phenomenon of formation of light-induced nonlinear photocurrent vortex crystals—i.e., 2D arrays of moiré-scale current vortices and associated magnetic fields. It provides a promising all-optical control route to manipulate such exotic photoexcited moiré quantum matter. Our findings illustrate the richness in the photophysics of vdW heterostructures and open opportunities for applications in optoelectronics and photovoltaics.

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