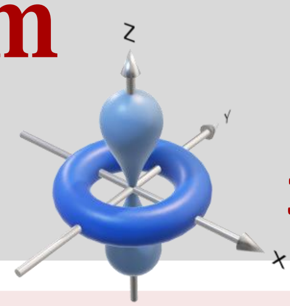
Department of Physics Colloquium



April 26, 2021 **3:00 PM**

Probing and Tuning Interlayer Interactions to Control Electronic and Photonic Properties of 2D Heterostructures

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Atomically thin, single crystalline 2D electronic materials have recently emerged, offering a remarkably wide range of building blocks of nanostructures, ranging from metals (e.g., graphene), large gap insulators (BN), to semiconductors (transition metal dichalcogenides and black phosphorous). One key advantage of these van der Waals materials lies in the flexibility of stacking different types of materials to form heterostructures, providing a design platform for achieving novel device functionality. In vdW hetero-bilayers, the interface encompasses the whole heterostructure and interlayer interactions become the controlling parameter for the electronic structure. In this talk I will first discuss directly probing the inter-layer interactions through the “lens” of moiré patterns using scanning tunneling microscopy and spectroscopy (STM/S). I will show that the interlayer coupling is strongly dependent on the inter-atomic alignment of the constituent layers. Moreover, as a consequence of moiré pattern formation, the energy band structure of the hetero-bilayer also shows lateral modulation, forming a 2D electronic superlattice. The moiré pattern “lens” also provides us with a means to measure the 2D strain tensor with high precision and high spatial resolution. In addition, the strain profile shows a direct correlation with the band gap modification. As the periodic potential modulation also provides lateral confinement for excitons, an intriguing scenario occurs – the 2D lateral superlattices also form 2D exciton quantum dot arrays. Recent reports of ultra-sharp atomic like spectra provide a direct confirmation of such a scenario. Finally, I will add another control knob and show evidence for valley spin mediated interlayer couplings, and their effect on excitonic states of the hetero-bilayer.

All colloquia will be held via Zoom. Link to the Zoom session will be provided via email and Canvas