

DEPARTMENT OF PHYSICS & ASTRONOMY

Physics & Astronomy Colloquium

Prof. Ming Xie

University of Texas-Dallas

(Host: Prof. Yun Suk Eo)

3:30 - 4:30 p.m. | Tuesday, April 7, 2026

Rm: ESB I 120



Title: Toward Bosonic Topological Quantum Phases in Moiré Superlattices

Moiré superlattices formed by stacking and slightly twisting atomically thin materials have recently emerged as a powerful platform for exploring quantum matter. Their exceptional tunability allows researchers to engineer flat energy bands and strong interactions, leading to a wide range of correlated and topological electronic phases. So far, most of these discoveries have focused on electrons. In this talk, I will discuss how similar ideas can be extended to bosonic particles, such as excitons (bound electron-hole pairs) and magnons (quantized spin waves), opening new directions for realizing topological quantum phases.

In the first part, I will present our recent theoretical proposal showing that engineering the layer degrees of freedom of excitons in a semiconductor heterostructure can produce nearly flat exciton bands with nontrivial topology. These “topological exciton bands” provide a bosonic analogue of well-known electronic topological models and offer a promising route toward interaction-driven phases such as bosonic fractional Chern insulators. In the second part, I will show that magnetic states in twisted semiconductor bilayers can host topological magnons. In these systems, the stability of magnetism is directly tied to the topology of the underlying state, and the magnon properties can be tuned using an external electric field. Together, these results highlight moiré materials as a versatile platform for designing and exploring new forms of topological quantum matter beyond electrons.

