CONDENSED MATTER SCIENCES SEMINAR

Professor Matthew Yankowitz

University of Washington

Host: Dr Cyprian Lewandowski

New twists on topology in moiré quantum matter

Friday, November 1st, 2024 15:00-16:00

ZOOM: https://fsu.zoom.us/j/95843288287

Moiré superlattices, formed by stacking and twisting atomically thin van der Waals crystals, have become a powerful platform for engineering flat electronic bands with intrinsic Berry curvature. Strong correlations in these materials can give rise to collective states of matter with nontrivial topology, establishing a new paradigm for creating and studying topological quantum many-body systems. I will first discuss scanning tunneling microscopy experiments where we probe the microscopic origins of band topology in semiconducting twisted MoTe2 by imaging its wavefunction structure, indicating the generation of a moiré-scale pseudomagnetic field. Then, I will present electrical transport measurements in twisted Bernal bilayer-trilayer graphene and rhombohedral pentalayer graphene moiré systems revealing integer quantum anomalous Hall states at fractional fillings of the superlattice bands. These Chern insulators arise due to the formation of topological electronic crystals, corresponding to unit-cell enlargements driven by the spontaneous breaking of discrete translational symmetry. In moiré pentalayer graphene, applying a modest magnetic field further induces an incipient fractional Chern insulator associated with ν = 2/3. Our findings showcase a diverse range of novel topological states that can arise in moiré materials, and lay the groundwork for future studies on topological charge crystallization and fractionalization.

Matthew Yankowitz is an Associate Professor of Physics and Materials Science & Engineering at the University of Washington. His research in experimental condensed matter physics focuses on the investigation and control of strong correlations, magnetism, superconductivity, and topology in two-dimensional van der Waals heterostructures, probed using a combination of electrical transport and scanning tunneling microscopy. Prior to joining the University of Washington, he was a postdoctoral researcher at Columbia University and received his Ph.D. in Physics from the University of Arizona. He is the recipient of an ARO Young Investigator Award (2020), an NSF CAREER Award (2021), the Lee Osheroff Richardson Science Prize from Oxford Instruments (2021), and the IUPAP Young Scientist Prize in Low Temperature Physics (2022).

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