



Colloquium

Exploring Quantum Hall Edge Channels in Graphene as a Path to Topological Superconductivity

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Topological superconductivity has attracted considerable attention due to its great promise for fault-tolerant quantum computing. Conventional approaches rely on intricate hybrid systems combining topological insulators and superconductors, requiring precise material engineering and fine-tuned conditions, yet a clear experimental demonstration remains absent to this day. In this colloquium, I will introduce a novel type of topological insulator state emerging from the physics of the quantum Hall effect. This state leverages the unique properties of the zeroth Landau level in graphene, a remarkable, strongly interacting flat band where electron-electron interactions give rise to diverse broken-symmetry phases, characterized by distinct topological and lattice-scale orders. These phases can be identified through transport measurements [1] and directly visualized using scanning tunneling spectroscopy [2]. I will also demonstrate how superconductivity can be induced in quantum Hall edge channels to create robust Josephson junctions, despite the presence of a strong perpendicular magnetic field [3], thus opening a new path toward the realization of topological superconductivity in quantum Hall Josephson junctions.[1] L. Veyrat et al. Science 367, 781 (2020)[2] A. Coissard et al. Nature 605, 51 (2022)[3] H. Vignaud et al. Nature 624, 545 (2023)

Tuesday, May 12, 2026 11:00am - 12:00pm

Office Bldg West / Ground floor / Heinzl Seminar Room (I21.EG.101)



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