Condensed Matter Theory Center Seminar
Tuesday, September 9 at 11:00 AM
2205 Physics Building

Speaker: Andrea Young (Pappalardo Fellow, MIT)

Title: Tuning and probing symmetry breaking in graphene quantum Hall ferromagnets

Abstract:

In monolayer and bilayer graphene, the carbon sublattices endow the electron wavefunctions with an additional valley degeneracy. At high magnetic fields, this manifests as highly symmetric multicomponent Landau levels, in which the dominant mechanism for symmetry breaking is due to electronic interactions. In this talk, I will discuss our recent efforts to probe and manipulate the resulting many body ground states. First I will describe experiments on charge neutral monolayer graphene, in which the nature of the symmetry breaking within the combined spin/valley space is directly linked to the edge state structure. Using large in-plane magnetic fields, we induce a quantum spin Hall (QSH) effect analogous to time reversal symmetry protected topological insulators but protected by an emergent spin-rotation symmetry. The properties of the resulting helical edge states can be modulated by balancing the applied field against an intrinsic antiferromagnetic instability, which tends to spontaneously break the spin-rotation symmetry. In the resulting canted antiferromagnetic (CAF) state, we observe transport signatures of gapped edge states, which constitute a new kind of one-dimensional electronic system with tunable band gap and associated spin-texture.

Finally I will discuss recent experiments in bilayer graphene, where the sublattices giving rise to the valley degeneracy are on different layers. We use this fact to capacitively detect the layer polarization in bilayer graphene, allowing us to directly constrain the order parameter across a wide range of parameters.

Host: Jay Sau

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