Interacting Electronic States in Graphene Heterostructures

Eric Spanton, UC Santa Barbara

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Interactions between electrons can lead to electronic states of matter which are long-range quantum entangled and exhibit striking phenomena such as spontaneous symmetry breaking, excitations which exhibit fractionalized charge, and superconductivity. Surprisingly, tape-exfoliated graphene has presented itself as one of the best materials to study this exotic and often fragile physics. I will describe our recent experiments on state-of-the-art graphene heterostructures, which utilize single crystal hexagonal boron nitride dielectrics and graphite gates to realize new electronic states. I will discuss unexpected even-denominator fractional quantum Hall states in monolayer graphene which arise due to the interplay of spin and valley degrees of freedom. Continuous control of angle between different layers is a unique feature of 2D materials such as graphene, and I will introduce a class of newly realized interaction-driven electronic states called fractional Chern insulators, which utilize close rotational alignment of graphene and hexagonal boron nitride crystals. These strongly interacting ground states open the study of new quantum phase transitions and creative routes towards probing exotic excitations.

Watch a video of the talk here.