HQOC

Harvard Quantum Optics Center

Monday, February 2, 4:00 pm

Jefferson 256

Javier Sanchez-Yamagishi

Massachusetts Institute of Technology

"Quantum Transport in Twisted Graphene Heterostructures"

Two-dimensional (2d) layered materials, such as graphene and hexagonal boron nitride (hBN), can be isolated separately and then stacked together to form heterostructures with perfectly crystalline interfaces between the layers. A endless diversity of electronic materials can be created in this way, with properties that derive from the constituent 2d layers and their interface interactions. I will present a series of experiments which show how the electronic properties of heterostructures made from graphene and hBN depend sensitively on the relative alignment, or "twist", between the layers. Depending on the twist angle, a layer of hBN can be either a non-perturbing substrate for the graphene, or a method to induce a band gap and superlattice potential for the graphene electrons. In the case of two stacked graphene layers, a relative twist can electronically decouple the layers from each other, despite a tiny 0.34nm interlayer spacing. I will show how we take advantage of this twist-dependent physics to realize new electronic states in graphene in the presence of both strong magnetic fields and the effects of electron-electron interactions. This includes both exploring the manifestation of Hofstadter's butterfly in graphene, as well as realizing novel 1-dimensional edge modes such as quantum spin Hall states.