Monica T. Allen

Graduate Institution: Harvard University

Graduate Discipline: Experimental Condensed Matter Physics

Hometown: Endicott, NY

Relevant SC Research: Basic Energy Sciences

Research Interest:

I am interested in using controlled nanoscale techniques to gain insight into the physical mechanisms that underlie a material's behavior. Most recently, we devised a new local gating approach to achieve quantum confinement in bilayer graphene, a thin sheet formed by two atomic layers of graphite. In this system, one may induce a tunable bandgap in the density of states by applying an electric field that breaks the inversion symmetry of the layers. This enables production of confined structures with tunable tunnel barriers, providing a new avenue for the exploration of quantum information processing in graphene.

I am also interested in Coulomb-driven broken symmetry quantum Hall states in suspended graphene and their evolution in both electric and magnetic fields. We have explored competing gapped phases in dual-gated bilayers and observe a new spontaneous insulating phase emerging at low densities and low fields. Use of high purity suspended devices gives us access to interaction driven effects visible only at low disorder, including a complete lifting of the eightfold degeneracy and highly resistive zero density state in magnetic field.

About Me:

I did my undergraduate work at Harvard, where I received a bachelor's degree in physics in 2009. My experience has been shaped by the people who have patiently allowed me a place in their labs over the past nine years. I have had the opportunity to study phase transitions of tin-based alloys in Cotts lab at the State University of New York at Binghamton, synthesis and mechanical characterization of thin film TiNiZr shape memory alloys in Vlassak lab at Harvard, Andreev reflection in Nb/Ge/Al superconductor junctions in Ong lab at Princeton, and Raman spectroscopy and fabrication of double-layer graphene devices in Yacoby lab at Harvard.

Currently I am a third year PhD student in physics at Harvard University. Under the direction of Prof. Amir Yacoby, my graduate research has focused on transport properties of suspended bilayer graphene. Previous research projects include electric field control over broken symmetry quantum Hall states, study of a new spontaneously gapped zero field phase, and gate-defined quantum confinement in bilayer graphene. I am a participant in monthly Boston Area CarbOn Nanoscience (BACON) meetings, which bring together nearby groups working on graphene and carbon nanotubes. I am also a member of the American Physical Society and have presented recent results at annual March Meetings. My outreach activities include volunteering with the Harvard Science Mentors Program and the Chinatown Afterschool Program. After graduate school, I would like to pursue a career in research.