Stanford University School of Humanities and Sciences

Department of Applied Physics

David Goldhaber-Gordon

Professor of Physics

Directory Link
Personal Website
Research Group Link

Research areas:
Condensed Matter, Materials Science, Nano Sci/Eng, Quantum Engineering, Quantum Many-Body Physics

Description

Condensed Matter Physics

The primary focus of the Goldhaber-Gordon lab is the experimental investigation of condensed matter physics in low-dimensional materials. Our current experiments cover an extensive range of materials and physical systems. Utilizing the resources of the SNF, SNL, Ginzton, and our own lab's extensive collection of experimental equipment, we use nanofabrication techniques to build the devices for our studies. We explore exotic phenomena such as the Kondo effect and 0.7 structure in quantum dots and quantum point contacts in 2-dimensional electron gases (2DEGs). We use scanning gate microscopes to study electron transport in graphene, networks of carbon nanotubes, bilayer 2DEGs and edge states in mercury telluride, a recently discovered topological insulator. We were among the first groups to locally gate graphene and study transport through p-n junctions, and we're continuing this work with studies of graphene nanoribbons and large area CVD-grown graphene. We have published papers on the physics of 1-dimensional systems including peapod carbon nanotubes and cleaved-edge overgrowth hole wires. Most recently, we've begun studying electrolytically gated systems with ultrahigh charge density.

Nanoscience and Quantum Engineering

In order to perform condensed matter physics experiments, the Goldhaber-Gordon lab fabricates nanoscale devices using a variety of novel materials and seeks to perform "quantum engineering" to determine the parameters for our experimental systems. For example, we have published a number of papers on graphene, carbon nanotubes and graphene nanoribbons. While we seek a better understanding of the physics of these systems, as a by-product of our research we have developed and published techniques to top-gate graphene, synthesize a novel type of carbon nanotube, and pattern graphene nanoribbons. We have also developed new models that allow us to engineer the quantum properties of nanoribbons, 2-dimensional electron gases in a variety of materials, and spins in quantum dots, among others.

Courses Taught

- Intermediate Physics Laboratory III: Project
- Electrons in Nanostructures

Selected Publications

- Unexpected features of branched flow through high-mobility two-dimensional electron gases
- Magnetic field dependence of the spin-1/2 and spin-1 Kondo effects in a quantum dot
- Universal scaling in nonequilibrium transport through a single channel Kondo dot
- Evidence of the role of contacts on the observed electron-hole asymmetry in graphene
- Quantum Dot Behavior in Graphene Nanoconstrictions
- Evidence for Klein Tunneling in Graphene p-n Junctions
- Charge Transport in Interpenetrating Networks of Semiconducting and Metallic Carbon Nanotubes
- Disorder-induced gap behavior in graphene nanoribbons
- Virtual scanning tunneling microscopy: A local spectroscopic probe of two-dimensional electron systems
- Spatially probed electron-electron scattering in a two-dimensional electron gas

More Faculty in This Theme

Benjamin Lev

David A. Reis

Daniel S. Fisher

Ian R. Fisher

Harold Y. Hwang

Aharon Kapitulnik