



Jerry Lai



Jill Wright

Matthew Grayson during a dress rehearsal for a performance of *Copenhagen* at Northwestern Technological Institute.

Matthew Grayson

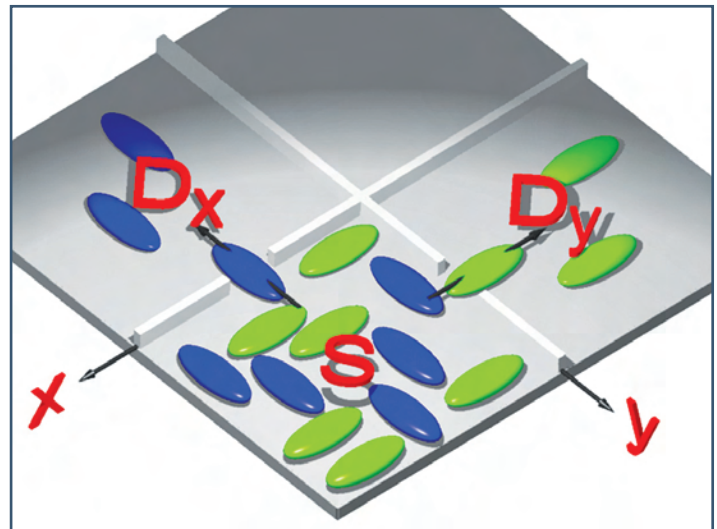
McCormick School of Engineering and Applied Science

Innovation through the Control of Electron Interactions

Matthew Grayson, electrical engineering and computer science, is researching new ways to get electrons to interact, either one at a time or collectively, since interaction is the key to controlling the charge on quantum scales for new device applications.

Grayson received an NSF CAREER Award to research new ways to sort electrons into two different groups and invent electronic devices whose behavior results from this distinguishability. Most electronic devices operate by sending electrons around a device for the purposes of signal amplification and logic switching. Certain semiconductors, however, host different kinds of electrons designated by their so-called “valley-index,” and new quantum device ideas and physical phenomena could be realized if it were possible to control and distinguish such electrons.

Grayson’s research will work to distinguish these different types of electrons and investigate simple electronic devices whose function results from this distinguishability. He will seek evidence for a rare quantum state of matter called a Bose-Einstein condensate under conditions where electrons from different valleys might be coerced to pair with each other.



New electronic devices will sort different types of electrons, analogous to narrow gates which only allow one geometrical shape to fit through.

Grayson also researches electron waves that occur both in one-dimensional wires as well as in the edges of the quantum Hall effect, whereby a magnetic field causes a sheet of electrons to behave like a liquid. Understanding the behavior of such electron waves is important for the design of future nanoscale electronics.

As part of his NSF CAREER Award, Grayson also produced and acted in a performance of *Copenhagen*, Michael Frayn’s drama about the social and moral responsibilities of technology. The play was performed at the McCormick School in September 2008, with the support of a Walter P. Murphy Society grant from the McCormick School under the aegis of ETOPiA: Engineering Transdisciplinary Outreach Project in the Arts, a program designed to enhance dialogue among researchers, students, and the community using scientifically themed plays. ■