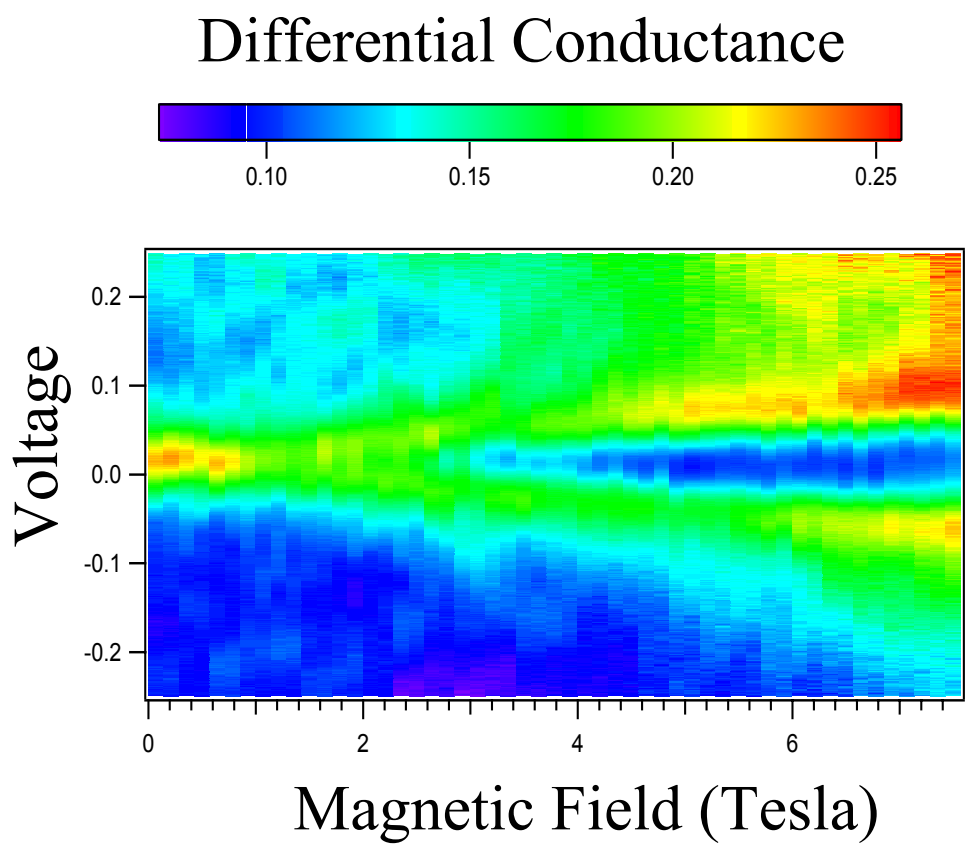
Manipulating the spin of a Single Electron
M. A. Kastner, MIT, DMR-0102153

Using nanotechnology we make transistors so small that they turn on or off with the addition of one electron. Now we are beginning to control the spin of that electron. Such control is of great fundamental importance and may also lead to applications such as quantum computers. Here we show the increase of current with voltage (on a color scale) through the transistor, for spin parallel (lower branch) and antiparallel (upper branch) to a magnetic field. The vertical voltage scale shows that it takes more energy to add the electron with anitparallel than parallel spin. Because the electron's wavefunction extends outside the transistor, the energy difference only appears above a critical field.



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Education:
Kastner's more than 20 graduate students have gone on to careers in research universities, teaching colleges, as well as large and small companies where they are involved in both research and management. Ten percent of his students have been African American and about 30% have been women. During the past year, he had two women postdoctoral associates and one woman undergraduate involved in his research program.

Outreach:
As Head of the MIT Department of Physics, Kastner plays an active role in several K-12 outreach programs. For example, he helps organize Physics lecturers for the MIT summer program for high school teachers. He also supervises faculty and staff who make numerous physics presentations for the lay community. He spends approximately 20 days per year visiting Physics alumni explaining to them the importance of supporting fundamental science.