Department of Physics
MCMICKEN COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APLICATION DEADLINE: March 1, 2006

The Department of Physics is pleased to offer the following research project for the summer of 2006. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

NANOSCALE TRANSPORT – KONDO EFFECT

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My group aims to understand the fundamental aspects of how electrons confined to a small region of space interact with each other and the surrounding world via precision transport measurements in artificially fabricated nanoscale electronic structures. We use single semiconductor-based quantum dots, which allow one to create a tiny (0.1 - 0.5 micron) electronic droplet whose parameters (energy, coupling to the surrounding conductors, number of the electrons in the droplet, their total spin, to name a few) can be directly controlled in the course of an experiment. Such droplets act like "artificial atoms" in the sense that the electrons are confined in space by an artificially constructed potential which, unlike that of a real atom, can be manipulated externally.

Our immediate goal is to further the understanding of a spin-related phenomenon called the Kondo effect, which occurs when a magnetic atom is allowed to interact with itinerant electrons. Using a quantum dot as a controllable "magnetic impurity," we aim to understand the properties of the many-body correlated electronic state which was shown to develop in such a system.

An undergraduate student would have the opportunity to get exposure to fundamental concepts in nanoscale transport, such as Coulomb blockade, co-tunneling, resonant tunneling, Kondo correlations, and spin -dependent transport, and be actively involved in measurements and data analysis. Several experimental projects are available depending on the student's preference: Constructing and testing electronic circuitry required to perform ultra-low noise transport measurements, developing novel microwave detection techniques, and developing novel types of single-electron devices.