PHYSICS DEPARTMENT COLLOQUIUM

"ARRAYS OF UNDOPED SILICON DOTS (10 nm or so in radius) CAN BE CHARGED UP WITH ELECTRONS TO BE FERRIMAGNETIC, METALLIC OR EVEN SUPERCONDUCTING"

BY

DR. Daniel C. Mattis
University of Utah

I shall describe special architectures in nanotechnology, specifically: various geometrical arrays of semiconducting material deposited on an insulating substratum, connected by narrow channels,in configurations such that the semiconductor elements are able to bencapacitatively charged. Optimal characteristic distances are calculated to be in the range of 10nm.

Such arrays have never been made before. They are predicted (purely by theory) to exhibit a novel form of ferrimagnetism (WITHOUT the introduction of magnetic ions.) As the electron occupation numbers are changed (by changing an external voltage,) metallic or even superconductive properties should appear in turn-- WITHOUT any chemical doping or ion implantation. The only chemical ingredient aside from an insulator substratum, is the intrinsic semiconductor. The desired effects are achieved purely by the choice of geometry and with just one variable parameter: the magnitude of
the potential that injects the electronic charges capacitatively into the semiconductor array. Small changes in this external voltage are amplified into large changes in electronic properties of the array, thus this effect should lead to a useful MOSFET device at the least. Applications to memory cells are also suggested.

Practical implementation will require state-of-the-art photolithography in the 10nm range. Because no ion implantation or chemical reactions are required, the arrays should be relatively simple to fabricate but the small characteristic sizes are at the limit of what is possible today.

THURSDAY, OCTOBER 9, 2003
4:00 PM IN 102 JFB
REFRESHMENTS AT 3:30 PM IN 219 JFB