UCLA Engineering
HENRY SAMUELI SCHOOL OF ENGINEERING AND APPLIED SCIENCE
Electrical Engineering Department

FENA

The MARCO FENA Center and the UCLA Department of Electrical Engineering are proud to present:

Dr. Matthew Gilbert

Assistant Director of the South West Academy of Nanoelectronics (SWAN)

"Many Body Quantum Transport Simulations of Strongly Correlated Quantum Systems"

Tuesday, 11/21/06 at 3:00pm (Pacific), 6:00pm (Eastern)
57-124 Engineering IV Building (on the UCLA campus)

Remote attendance details below**

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ABSTRACT

Power dissipation in future generation CMOS devices has fueled the search for new computational state variables. Of the new variables under consideration spin has been one of the most popular. Furthermore, the small dimensions of these devices increase the interaction strength and correlation strengths of the transport electrons. These devices are predicted to undergo dramatic transitions. To properly evaluate these new computational state variables, new tool will be required. While simulations including electron-electron interaction effects through local density approximations are adequate in certain circumstances, they are unable to capture the true nature of these effects and frequently critical many body effects arising from the non-local nature exchange and correlation are missed. In the second part of this work, we present a finite temperature path integral method for calculating the many body conductance of semiconductor nanostructures in 1, 2 and 3 dimensions by using imaginary time current-current correlation functions for systems containing hundreds of interacting electrons. When our method is compared to the simple analytical result for accuracy, we find that our method is accurate to within 5% of the analytical solution at temperatures from 0K to T_{Fermi}.

Furthermore, we present results of many body quantum transport calculations of strongly correlated quantum wires (QW) and quantum point contacts (QPC). We find that at around 1 G_0 Friedel oscillations are prevalent in the channel of the QPC pinned to the channel entrance and exit. When the gate voltage of the QPC is decreased below the conductance quantum, the Friedel oscillations become frustrated as we form a Néel state in the channel characterized by persistent global anti-ferromagnetic ordering. We examine the quasi-1D QW channel of the QPC as a function of density and potential curvature to further explore the possibility of ferromagnetic global ground states and spin-charge separation. We further discuss the use of such ordering in liquid-strongly correlated 1D-liquid systems as candidates for dissipationless spin transport.

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