The Abdus Salam International Centre for Theoretical Physics

United Nations Educational, Scientific and Cultural Organization

International Atomic Energy Agency

Conference on Strongly Interacting Systems at the Nanoscale

(8 - 12 August 2005)

co-sponsored by
ONRG – Office of Naval Research Global,
EOARD – European Office of Aerospace Research and Development of the USAF,
I^2CAM – International Institute for Complex Adaptive Matter

ABSTRACTS

of

TALKS and POSTERS

updated 31.8.2005

TALKS

Boris Altshuler (Princeton)

To be confirmed

Natan Andrei (Rutgers)

"Non-Equilibrium Transport in Quantum Impurities"

Leon Balents (Santa Barbara)

"Frustrating Mott physics of bosons on the triangular lattice"

Bosons near half-filling on the triangular lattice with repulsive interactions provide an interesting model of charge frustration. This talk describes a theory of this system based on proximity to a Mott transition, and formulated in terms of the elementary topological vortex excitations of the superfluid. Frustration leads to the "accidental" degeneracy of many different charge-ordered Mott states, which manifests itself as an emergent approximate [U(1)\times SU(2)] symmetry in the theory. This leads to an unusual character of the excitations in the Mott phase, and a natural interpretation in that context of the recent numerical observations of a supersolid phase in such a model. A number of puzzling features of these numerical results can be explained by the proximity to the Mott insulator. Some simple physical cartoons of these phases will be presented, along with an explanation of how unconventional "deconfined" quantum criticality may arise in this context.

Denis Basko (Princeton)

"Metal-insulator transition in a weakly interacting many-electron system with localized single-particle states"

We consider low-temperature behavior of weakly interacting electrons in disordered conductors in the regime when all single-particle eigenstates are localized by the quenched disorder. We prove that in the absence of coupling of the electrons to any external bath dc electrical conductivity exactly vanishes as long as the temperature T does not exceed some finite value T_c. At the same time, it can be also proven that at high enough T the conductivity is finite. These two statements imply that the system undergoes a finite temperature metal-insulator transition, which can be viewed as Anderson-like localization of many-body wave functions in the Fock space. As a result, in the insulating electron-electron interaction alone is unable to cause the relaxation and establish the thermal equilibrium. As soon as some weak coupling to a bath is turned on, conductivity becomes finite even in the insulating phase.

Vadim Cheianov (Lancaster)

"Exact results for the three-particle decay rate in a strongly correlated one-dimensional bose gas"

This work is motivated by recent experiment [B.Laburthe Tolra et al., Phys. Rev. Lett. ***92****, 190401 (2004)], where the influence of reduced dimensionality on the three-particle decay rates in atomic condensates was investigated. Using the integrable Lieb-Liniger model for the description of the one-dimensional gas we derive an exact expression for the correlation function describing the three-particle collision rate. The answer is given in terms of the thermodynamic parameters of the LL model. It is valid for all values of the dimensionless coupling γ and contains the previously known results for the Bogoliubov and Tonks-Girardeau regimes as limiting cases. We also investigate finite size effects by calculating the correlation function for small systems of 3, 4 and 5 particles.*

Andrey Chubukov (Maryland)

"Non-analyticities in 2D and 3D Ferni liquids"

Roberta Citro (Salerno)

“Spin and charge pumping in an interacting quantum wire”

A study of the charge and spin pumping in an interacting one-dimensional wire is presented. It is shown that a spatially periodic potential, oscillating in time with frequency ω_0 acts as a quantum pump inducing a dc--current component at zero bias. The current generated by the pump is strongly affected by the interactions. It has a power law dependence on the frequency or temperature with the exponent determined by the interaction in the wire only, while the coupling to the pump affects the amplitudes. We also show that pure spin-pumping can be achieved, without assuming spin orbit coupling or the presence of a magnetic field.

William Coish (Basel)

"Hyperfine interaction in a two-electron double quantum dot"

Silvano De Franceschi (Trieste)

“Quantum Transport Phenomena in Nanowires and Nanotubes”

Nanostructured materials offer unique opportunities to create simple *and* tuneable *electronic systems in which complex quantum phenomena can be investigated. In this talk I will discuss various aspects of quantum transport in three-terminal field-effect devices based on individual semiconductor nanowires and nanotubes.*

I will consider first the case of quantum-dot nanostructures in which Coulomb blockade effects play a dominant role. A quantum dot confining a finite electronic spin can be regarded as an artificial magnetic impurity and it can give rise to Kondo effect. This phenomenon has been widely explored in semiconductor quantum dot devices. Here, I will report on the observation of a spin-less Kondo effect in carbon nanotubes. In this case, the role of spin is taken over by an orbital degeneracy arising from the two equivalent ways electrons can circle around the circumference of a nanotube.

I will then focus on semiconductor nanowires strongly connected to superconducting electrodes. Here Coulomb interactions are suppressed and superconducting correlations can be induced in the nanowire due to the proximity effect. Under these circumstances, the nanowires form superconducting weak links operating as mesoscopic Josephson junctions with electrically tunable coupling.

Matthias Eschrig (Karlsruhe)

”Interplay of ferromagnetic and superconducting proximity effects”

We present theoretical results on the interplay of magnetic and superconducting orders in mesoscopic ferromagnet-superconductor-hybrid structures. Induced spin-triplet correlations in such structures are shown to be important for both the ballistic and the diffusive limit. Whereas in the ballistic case the p-wave character of the triplet correlations dominates the physics, in the diffusive case the odd-energy s-wave triplet correlations lead to interesting effects. We propose to use the torque on a FSF tri-layer in an external magnetic field as a probe of the presence of triplet correlations in the superconducting phase.

Karsten Flensberg (Niels Bohr Institute Copenhagen)

“Electron-vibron correlations in molecular transistors”

I discuss coupling between electron transport and vibrational degrees of freedom in mesoscopic and molecular systems. The coupling gives rise several effects such as sidebands in the differential conductance, rectification due to polaron formation,and interesting interplay with the Kondo resonance.

Akira Furusaki (RIKEN)

"Renormalization of impurity scattering in 1D interacting electron systems in magnetic field"

I will discuss the renormalization of a single impurity potential in one-dimensional interacting electron systems in the presence of magnetic field. With the bosonization technique and Bethe ansatz solutions, the renormalization group flow diagram is determined for the amplitudes of scattering of up- and down-spin electrons by the impurity in a quantum wire and in the Hubbard model. It was found that in a strong magnetic field the interaction may suppress the backscattering of majority-spin electrons by the impurity potential in the vicinity of the weak-potential fixed point. This implies that in a certain temperature range the impurity becomes almost transparent for the majority-spin electrons while it is impenetrable for the minority-spin ones. The impurity potential can thus have a strong spin-filtering effect.

This is a work done in collaboration with T. Hikihara and K.A. Matveev.

Leonid Glazman (Minnesota)

"Energy-resolved inelastic scattering off a magnetic impurity"

We investigate the loss of energy by an electron scattered off a magnetic impurity in a metal. If the initial electron energy E (measured from the Fermi level) is high compared to the Kondo temperature, then the scattering is predominantly inelastic. However, the characteristic energy loss in the scattering event is small compared to E and is determined by the Kondo energy scale or, at higher temperatures, by the Korringa relaxation rate. We find the full energy dependence of the corresponding scattering cross-section by relating it to the dissipative part of susceptibility of the magnetic impurity. Effects of a magnetic field and temperature on the energy-resolved scattering cross-section are fully characterized. This cross-section may be extracted from experiments with hot electrons in nanowires and quantum dots.

Igor Gornyi (Karlsruhe)

"Interaction effects on magneto-oscillations in a two-dimensional electron gas"

Matthew Hastings (Los Alamos)

"Slow Polaron Dynamics via Non-Equilibrium Born-Oppenheimer"

We consider the non-equilibrium dynamics of a molecular level interacting with local phonon modes in the strong coupling regime. We find that in an adiabatic regime when the electronic states react faster than the phonon modes it is possible to provide a fully non-perturbative treatment of the phonon dynamics including random noise and dissipation using a non-equilibrium Born-Oppenheimer approximation. The result shows intermittent switching between bi-stable states of the oscillator driven by an effective temperature.

Marcus Kindermann (Cornell)

"Transport through a clean interacting wire: exactly solvable limits"

The conductance through thin ballistic wires in the absence of electron interactions is quantized in units of the conductance quantum 2e^2/h (in case of a two-fold spin degeneracy). Several experiments on quantum point contacts and more recently also carbon nanotubes indicate, however, deviations from this quantization that are attributed to electron-electron interactions. The formation of a Wigner crystal has recently been proposed as their origin.
In this talk I will present a study of an interacting quantum wire in a related regime: that of the ``Coulomb Tonks gas'' of impenetrable electrons. It can be realized in ultra-thin wires, such as carbon nanotubes. We have studied transport through a finite-length Coulomb Tonks gas connected to bulk leads in various exactly solvable limits, both in and out of equilibrium. While we find a reduction of the conductance of such

a wire to e^2/h in all cases, the current in the wire does not exhibit any fluctuations at zero temperature. Most importantly, our model demonstrates that such a noise suppression does not require spin polarization of the wire. Instead we find that the predicted noiseless charge current is accompanied by pronounced spin current fluctuations. This suggests that current noise measurements performed on conductors with anomalously reduced conductance could give strong evidence for the mechanism of conductance reduction we have studied. Noise measurements at the ``0.7-plateau'' of quantum point contacts have already shown a tendency of noise reduction.

Austin Lamacraft (Princeton)

"Damping of breathing modes of a trapped Fermi gas near the superfluid transition"

One common probe of a trapped atomic gas is a measurement of the breathing modes excited by temporarily releasing the trap. Trap frequencies however display a rather smooth dependence on interaction strength, and deviations from free particle results are at most of order one. On the other hand, recent experiments on Fermi gases indicate singular behavior in the damping of the breathing modes. In this talk I will discuss the effect of superfluid fluctuations on the breathing modes near the transition temperature.

Igor Lerner (Birmingham)

"Decoherence and relaxation in charge qubit"

Daniel Loss (Basel)

"Electron spin decoherence in single and double quantum dots"

Charles Marcus (Harvard)

"Quantum Circuits"

Alexander Mirlin (Karlsruhe)

"Interacting electrons in disordered quantum wires: Localization and dephasing

Aditi Mitra (Columbia)

"Non-equilibrium transport in quantum impurity models"

Cord Müller (Bayreuth)

"Localization of matter waves in 2D-disordered optical potentials"

The quantum physics of condensed matter can be studied with ultracold atomic gases in optical potentials that can almost be tailored at will. I will report theoretical results on the disorder-induced localization of matter waves in 2D speckle potentials. Using diagrammatic Green's function techniques, we calculate the diffusion constant for noninteracting matter waves from the microscopic description of the correlated potential. The weak localization correction is evaluated, and we give an estimate for the localization length at the crossover to the Anderson-localized regime which is shown to be accessible in current state-of-the-art experiments.

Yuly Nazarov (Delft)

“Nuclear magnetic field in quantum dots”

Tomas Novotny (Copenhagen)

"Charge transport statistics of quantum shuttles"

Emiliano Papa (Austin Texas)

“Quantum Hall line Junctions, and gated edge states in quantum point constriction”

I address in this talk the properties of quantum Hall line junctions, one-dimensional electron systems that occur near barriers between two-dimensional electron gases on quantum Hall plateaus. Quantum Hall line junctions are described at low energies by generalized sine-Gordon models. I propose procedures that can be used to reliably estimate the parameters that characterize these models and apply them to several different physically relevant situations. Finally, I discuss a number of sine-Gordon model properties that are experimentally relevant for quantum Hall line junctions, including the magnitude of the charge gap, the Drude weight of the ac conductivity when the chemical potential lies outside the gap, and the temperature dependence of line junction transport properties.

Related but slightly different from the above, I will also talk about transport properties of edges formed in gated quantum point constrictions used in recent experiments of V. Pellegrini et al.. These experiments observe unusual G-V behavior at ν=1 filling fractions, in contradiction with theoretical expectations. I discuss some of reasons for this happening and give some ideas and directions for future work.

Anna Posazhennikova (Karlsruhe)

“Underscreened Kondo physics of a spin 1 quantum dot”

We interpret the recent observation of a zero-bias anomaly in spin-1 quantum dots in terms of an underscreened Kondo effect. We argue that in the large temperature range the physics of a spin-1 QD is dominated by underscreened Kondo effect. General arguments, based on the asymptotic decoupling between the partially screened moment and the leads, predict a singular temperature and voltage dependence of the conductance G and differential conductance g, resulting in $dg/dT\sim 1/T$ and $dG/dV \sim 1/V$. Using a Schwinger boson approach, we show how these qualitative expectations are borne out in a detailed many body calculation.

Michael Pustilnik (Georgia Tech.)

"Quantum dot as a perfect spin filter"

Georgy Shlyapnikov (Orsay)

“Strongly interacting Fermi gases in the molecular and unitarity regimes”

Matthias Troyer (ETH Zürich)

“Stability of Lattice Supersolids”

Alexey Tsvelik (Brookhaven)

"Finite temperature correlation functions in integrable systems: exact results"

We propose an approach to the problem of finite temperature dynamical correlation functions in integrable one-dimensional models with a spectral gap. The approach is based on the analysis of the singularities of the operator matrix elements and is not model specific. For the long time, large distance asymptotics of the correlation functions we obtain a formula which, as a particular case, contains the expression for the dynamical susceptibility of Quantum Ising model suggested by Sachdev and Young, Phys. Rev. Lett. ***78****, 2220 (1997).*

Amir Yacoby (Weizmann Institute)

"Electrons in one-dimension: spin-charge separation and localization"

Nick Zhitenev (Bell Labs Lucent Technologies - Murray Hill)

"Nano- and Mesoscale Molecular Junctions: Control of Chemical Bonds and Surface Topography at Metal-Molecule interface."

Using molecules in electronics has an enormous appeal. In the size hierarchy of nature, molecules stand just above atoms making them ideal ultimate choice for ever-shrinking electronic devices. Reaction chemistry offers vast diversity of molecular substructures and chemical transformations. However, wiring the molecules in a macroscopic circuit remains a challenging problem. In this talk, I present two approaches that we use to build small molecular structures. The first group of experiments is targeted toward wiring of a single or just a few molecules. We found that the conductance mechanisms observed in such ultra-small devices differ dramatically from predicted transport through molecules. The electronic states mediating the transport are never the expected electronic states of the molecules. To detect the conductance associated with the molecular states, we have developed high-yield process based on prefabricated nano-templates to screen the properties of larger molecular junctions with characteristic size of ~50-300 nm. The approach readily permits to experiment with the topography and the chemical bonding at metal-molecule interface and to control the metal diffusion through the layers. For the first time, we directly compare the properties of conjugated versus saturated molecules with the length ~ 2 nm. Surprisingly, the results show that the molecular states of both type of molecules display nearly undetectable conductance contrary to numerous calculations and experiments.

P O S T E R S

Shaffique Adam (Cornell, NY, USA)

Current induced Instabilities in nanomagnets

S. Adam, M. L. Polianski and P. W. Brouwer
Laboratory of Atomic and Solid State Physics Cornell University, Ithaca, NY 14853

A sufficiently large unpolarized current can cause spin-wave instabilities in thin nanomagnets with asymmetric contacts. The magnet dynamics close to onset of the instability is shown to be spin waves with elliptical motion. Dynamics beyond the instability is understood by numerically solving a discrete model that shows a transition from well-defined periodic orbits into non-ergodic and finally chaotic behavior. We investigate the effects of this crossover on physical observables like resistance.

Enrico Arrigoni (Graz, Austria)

Weak tendency to phase separation in electron-doped cuprates

Reza Asgari (I.P.M., Tehran, Iran)

Ground-state densities and pair correlation fucntions in parabolic quantum dots

We present an extensive comparative study of ground-state densities and pair distribution functions for electrons confined in two-dimensional parabolic quantum dots over a broad range of coupling strength and electron number. We first use spin-density-functional theory to determine spin densities that are compared with Diffusion Monte Carlo (9DMC) data. This accurate knowledge of one-body properties is then used to construct and test a local approximation for the electron-pair correlations. We find very satisfactory agreement between this local scheme and the available DMC data, and provide a detailed picture of two-body correlations in a coupling-strength regime preceding the formation of Wigner-like electron ordering.

Soraya Bachaoui (USTO, LEPM, Oran, Algeria)

Analysis of TL glow curves based on the model of two trappings levels application to ∞-AL_2O_3

S S.Bachaoui[1], R.Bouamrane[1,2], Nouredine.Zekri[1,3]
1-Université Es-Senia Oran, Faculté de Médecine. Oran, Algeria 2-U.S.T.O., Departement de Physique, L.E.P.M B.P.1505 El M'Naouar, Oran, Algeria. 3-U.S.T.O., Departement de Physique, L.E.P.M B.P.1505 El M'Naouar, Oran, Algeria.

The dosimetric peak D' of thermoluminescence emitted from alpha-alumina (∞-Al_2O_3) is numerically analysed with a model in which electron traps are continuously distributed. The model of a single and different trapping level were compared in describing the L glow curve D'. The model in which electron traps are presented with two continuously distributed electron or traps give the best fit trap parameters :1)the gap between trapping levels ∞∞ and the characteristic depth of the trap distribution ∞ ;2)the rates of recombination ∞ ,retrapping ∞ and detrapping of the released electron ∞.The procedure of the TL analysis using a Gaussian distribution is also reported in detail.

Ioan Baldea (Inst.Space Sciences, Bucharest, Romania)

Ioan Baldea and Lorenz S. Cederbaum

Effect of strong correlations on photoionization of quantum dot nanorings

We present exact numerical results indicating that ionization could be a useful tool to study electron correlations in artificial molecules and nanoarrays of metallic quantum dots (QDs). For nanorings consisting of Ag QDs of the type already fabricated, we demonstrated (I.Baldea and L.S. Cederbaum, Phys. Rev. Lett 89, 13303 (2002) that the molecular orbital picture breaks down even for lowest energy ionization processes, in contrast to ordinary molecules. Our ionization results yield a transition point between localization and delocalization regimes in good agreement with various experimental data. The present results present a systematic analysis of the full ionization spectra in Ag Qds assembled in nanorings.

Yamina Bennabi (USTO, LEPM, Oran, Algeria)

Independent time Schrodinger equation in the case of complex potential in 1D ordered active system

Carlos Bolech Gret (Geneva, Switzerland)

Title to be confirmed

Cabo Montes de Oca Alejandro Genaro (La Habana, Cuba)

About the role of the 2D screening in HTSC

authors: Y. Vazquez-Ponce, D. Oliva and A. Cabo

The 2D screening is investigated in a framework of a simple single band square tight-binding model qualitatively resembling the known properties of the electronic structure in high temperature superconductors. The one loop coulomb kernel for the Bethe-Salpeter equation associated to two particles in the reduced single band approximation can be evaluated in a strong tight binding limit. The results indicate an intense screening of the hard Coulomb repulsion between two particles which becomes stronger and anisotropic when the fermi level approach half filling. Moreover, the dielectric function gets its maxima for quasi-momenta being near the corners of the Brillouin cell, that is, for dual spatial distances of the order of few unit cells. Therefore, a mechanism seems to be detected which could explain the existence of the extremely small Cooper pairs in these materials as bounded anisotropic pairs formed by residual super-exchange or phonon interactions.

Carlo Canali (Kalmar, Sweden)

Electron-magnon coupling and non-linear tunneling transport in magnetic nanoparticles

Single-electron tunneling experiments[1] on ultra-small magnetic nanoparticles have shown that the excitations of spin collective modes, or magnons, strongly influence transport in the nonlinear regime. A recent microscopic analysis[2] of the elementary excitations in ferromagnetic nanoparticles has pointed out that for particle sizes relevant to these experiments, the spin collective modes are likely to couple strongly to discrete particle-hole excitation by means of the spin-orbit interaction. In this paper we study nonlinear transport within a model Hamiltonian where quasi-particle excitations scatter off boson modes describing the ferromagnetic collective excitations. The model employed to describe the isolated nanoparticle is a two-level system familiar in quantum optics, which can be solved exactly. Our analysis of quantum transport in the regime of weak coupling to the external electrodes is based on a rate-equation formalism for the nanoparticle occupation probability. For strong electron-boson coupling and when the bare quasi-particle level spacing is in resonance with the boson frequency, we find that the tunneling conductance as a function of bias is characterized by fine structure related to transitions between the many-body states of the system. Under certain circumstances, negative differential conductance is also observed.

Hossein Cheraghchi (Sharif Univ., Tehran, Iran)

Localization properties of one dimensional off-diagonal disorder near the band center

The localization behavior of the one dimensional Anderson model with correlated and uncorrelated purely off-diagonal disorder is being studied. Using the transfer matrix method, we derive an analytical expression for the localization length in terms of the pair correlation function at the middle of the band. It is proved that a localization-delocalization transition can occur for long-range correlated hopping disorder with Hurst exponent (H> 1/2), when the variance of the logarithm of hopping "_ln(t) " is kept fixed with the system size N. Based on numerical calculations, finite size scaling relations are postulated for the localization length near the band center (E = 0) in terms of the system parameters: E,N,H, and _λn(t). In this letter, we have investigated the 1D Anderson model with correlated and uncorrelated hopping disorder exactly analytically at E=0 (Fermi level), and numerically at other energy values near the band center. We find that regardless of the probability distribution of hopping terms, in the case of uncorrelated disorder, in agreement with [2], but in contrast with the calculation of Ref.[1], the E=0 state is anomalously localized (_localization ∞ N1/2/_ln(t)). In the correlated disordered case at zero energy, we derive an analytical expression for the localization length in terms of the pair correlation function. In the case of a Log Normal distribution function of hopping disorder with normalized long-range correlations, we prove that there is a localization-delocalization transition which has the same critical exponent as the diagonal disorder case Hc =1/2 [4] for all energies near the band center. This is in contrast with the numerical studies of Ref. [3] which concluded that Hc = 0. Here Hc is the critical value of the Hurst exponent. The localization length is shown to have a power law behavior versus size at the band center. We will show that the localization properties at E=0 can be extended to other energies around the band center, if the size is smaller than a critical length, while systems with a size larger than the critical length are in the localized regime.

Chung-Hou Chung (Karlsruhe, Germany)

Critical properties and quantum phase transitions of the Bose-Fermi Anderson model:
application to the Coulomb Blockade of a noisy quantum dot

Anna Ciechan (Lublin, Poland)

Finite size corrections in the two-level BCS model

The properties of nanoscale materials differ from those observed in bulk systems due to discrete structure of their energy spectrum. In this work the small superconducting grains modeled by two level system has been studied. The finite size corrections to the ground state energy, the average number of particles in each level and other characteristics of the system has been studied by many direct solution of the Richardon's model. We compare our results with those found by other techniques.

Ivan Dmitriev (Ioffe Inst.,St.Petersburg, Russia)

Recent progress in the theory of the microwave-induced phenomena in a 2D electron gas

Agnieszka Donabidowicz (Lublin, Poland)

Thermoelectric power of the asymmetrically coupled quantum dot

We investigate the thermoelectric power of the quantum dot which is asymmetrically coupled to external leads. To account for the strong correlation effects we use the equation of motion technique for the nonequilibrium Keldysh Green's functions. We determine temperature dependence of the thermopower for systems with various Coulomb interactions, several asymmetric couplings to the leads and different positions of the on dot energy levels. Influence of the Van Hove singularities in the density of states is also discussed.

Markus Garst (Univ. Minnesota, Minneapolis, USA)

Inelastic electron scattering off magnetic impurities

We study inelastic scattering of energetic electrons off a Kondo impurity. If the energy E of the incoming electron (measured from the Fermi level) exceeds significantly the Kondo temperature T_K the differential inelastic cross-section \$\sigma (E, ω) , { i.e.}, the cross-section characterizing scattering of an electron with a given energy transfer ω , is well-defined. We show that $\sigma_\iota (E, \omega)$ factorizes into two parts. The E-dependence of \$\sigma (E, ω) is logarithmically weak and is due to the Kondo renormalization of the effective coupling. We are able to relate the \$\omega\$--dependence to the spin-spin correlation function of the magnetic impurity. Using this relation, we demonstrate that in the absence of a magnetic field the dynamics of the impurity spin causes the electron scattering to be inelastic at any temperature. At temperatures T low compared to the Kondo temperature T_K, the cross-section is strongly asymmetric in ω and has a well-pronounced maximum at $h\omega \sim T_K$. At $T \gg T_K$, the dependence σ_ι vs. ω has a maximum at ω=0; the width of the maximum exceeds T_K /h and is determined by the Korringa relaxation time of the magnetic impurity. Quenching of the spin dynamics by an applied magnetic field results in a finite elastic *component of the electron scattering cross-section. The differential scattering cross-section may be extracted from the measurements of relaxation of hot electrons injected in conductors containing localized spins.*

Federica Haupt (Univ. Genova, Italy)

Shot noise in charge and magnetization currents in a quantum ring

The shot noise of a quantum ring connected to leads via tunneling barriers shows interesting features related to the interplay between Coulomb Blockade effects, Luttinger Liquid (LL) correlations and Aharonov-Bohm. Both charge-and angular-resolved noise correlators have been studied and have been found to have distinctly different behaviours. Noise in the total current is due to the discreteness of the electron charge and can become super-Poissonian as result of electron interaction. In contrast, the noise of the angular magnetization current in the ring is comparatively insensitive to the interaction, except if an inversion of the populating ratio of the angular states is realized. The characteristic time scales in different regimes are studied by a Monte-Carlo simulation.

Manuel Houzet (SPSMS/DRFMC, Grenoble, France)

Quantum charge fluctuations in a superconducting grain

M. Houzet (1,2), D.A. Pesin (3), A.V. Andreev (3), L.I. Glazman (1)
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We consider charge quantization in a small superconducting grain that is contacted by a normal-metal electrode and is controlled by a capacitively coupled gate. At zero temperature and zero conductance G between the grain and the electrode, the charge Q as a function of the gate voltage V_g changes in steps. The step height is e if the superconducting gap of the grain is smaller than its charging energy. Quantum charge fluctuations at finite conductance remove the discontinuity in the dependence of Q on V_g and lead to a finite step width, proportional to G^2. The resulting shape of the Coulomb blockade staircase is of a novel type. The grain charge is a continuous function of V_g while the differential capacitance, dQ/dV_g, has discontinuities at certain values of the gate voltage. We determine analytically the shape of the Coulomb blockade staircase also at non-zero temperatures.

Ki-Seok KIM (KIAS, Seoul, Korea)

"Effect of nonmagnetic disorder on criticality in the "dirty" U(1) spin liquid."

This article can be found in "cond-mat/0501656," and accepted in Phys. Rev. B.

"We investigate the effect of nonmagnetic disorder on the stability of the algebraic spin liquid (ASL) by deriving an effective field theory, nonlinear σ model ($NL{\sigma}M$). We findthat the anomalous critical exponent characterizing the criticality of the ASL causes an anomalous gradient in the $NL{\sigma}M$. We show that the sign of the anomalous gradient exponent or the critical exponent of the ASL determines the stability of the "dirty" ASL. A positive exponent results in an unstable fixed point separating delocalized and localized phases, which is consistent with our previous study [Phys. Rev. B {\bf 70}, 140405 (2004)]. We find power law suppression for the density of spinon states in contrast to the logarithmic correction in the free Dirac theory. On the other hand, a negative exponent destabilizes the ASL, causing the Anderson localization. We discuss the implication of our study in the pseudogap phase of high T_c cuprates."

Mikhail Kiselev (Ludwig Maximilians Univ., Munich, Germany)

The Interplay of Spin and Charge Channels in Zero Dimensional System

M.Kiselev and Yuval Gefen

We present a full fledged quantum mechanical treatment of the interplay between the charge and spin zero-mode interactions in quantum dots. Quantum fluctuations of the spin-mode suppress the Coulomb blockade and give rise to non-monotonic behavior of the tunneling DoS. They also greatly enhance the dynamic susceptibility. Transverse fluctuations become important as one approaches the Stoner instability. We discuss both transport through the quantum dot and the dynamic magnetic response functions of the qot.

Dmitry Lobaskin (Univ. Augsburg, Germany)

"Non-Equilibirum Kondo Model with a Factorized Initial State"

We present results for a non-equilibrium magnetization and spin-spin correlation functions at the Toulouse point and in the experimentally relevant Kondo limit of the non-equilibrium Kondo model. Non-equilibrium in the original Kondo model is introduced by the initially prepared Eigenstate of the impurity spin. Such initial non-equilibrium states can e.g. be realized in quantum dot experiments with time-dependent gate voltages. We also present results for a buildup of the Kondo resonance in the non-equilibrium quasi-particle spectral density of a quantum dot subjected to initial preparation.
Another important result is the violation of the fluctuation-dissipation theorem in such a non-equilibrium system. The fluctuation-dissipation theorem (FDT) plays a fundamental role in understanding quantum many-body problems. However, its applicability is limited to equilibrium systems and it does in general not hold in non-equilibrium situations. This violation of the FDT is an important tool for studying non-equilibrium physics. We derive exact analytical results at the Toulouse point, and results within a controlled approximation in the Kondo limit, which allow us to study the FDT violation on all time scales. A measure of the FDT violation is provided by the effective temperature, which shows initial heating effects after switching on the perturbation, and then exponential cooling to zero temperature as the Kondo system reaches equilibrium.

Ricardo E. Marotti (Inst.Fisica, Montevideo, Uruguay)

"Optical properties of copper and silver nanowires embedded in a nanoporous alumina template"

R. E. Marotti[1 *], *S. Green*[1-2], *A. Cortes*[3], *G. Riveros*[3-4], *H. Gómez*[3], *E. A. Dalchiele*[1]
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[2] *Department of Physics, Umeä University, Umeä, Sweden.*
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[4] *Departamento de Química, Facultad de Ciencias, Universidad de Chile, Santiago de Chile, Chile.*

The optical properties of metallic nanowires embedded in a dielectric porous template are investigated. The porous dielectric templates used were nanoporous alumina membranes, while the metallic nanowires under study were both grown of copper and silver. The optical properties of the single membranes (unfilled pores) and the resulting composite material (for both copper and silver) are compared between them.
The porous alumina membranes can be prepared by electrochemical anodization of high purity aluminium foil, but they are also commercially available. The details on the anodization process allows to control the pore distribution of the resulting porous alumina templates, mainly the mean porous diameter can be vary between few tens of nanometers to few hundreds of nanometers. A good regular hexagonal distribution of these pores is also obtainable. The metallic wires are grown inside the pores by electrochemical deposition [1] Copper and silver were chosen as the metallic materials because of they very high plasma frequency to loss energy ratio (in comparison to other metals), that would allow to control the plasmon frequency of the metallic nanostructure.
The resulting sample structural, morphological and chemical properties were studied by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS), respectively. The optical properties of the composite material were studied mainly by diffuse reflectance spectroscopy (DRS). As the samples can show anisotropic properties, several geometric angular configurations were used. The results for the metallo-dielectric composite material can be understood in a first approximation by a simple Bruggeman model, reflecting the influence of each metal in the properties of the composite materials.

[1] - "Crystallograpically-oriented single-crystalline copper nanowire arrays electrochemically grown into nanoporous anodicalumina templates", G. Riveros, H. Gómez, A. Cortes, R. E. Marotti, E. A. Dalchiele, accepted for publication in Applied Physics A: Materials Science and Processing. (DOI: 10.1007/s00339-004-3112-1).

Pedro A. Orellana (Univ. Catolica del Norte, Antofagasta, Chile)

"Kondo effect in side coupled double quantum-dot molecule"

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The Kondo effect in quantum dots has been extensively studied in the last years The quantum dots allow to study systematically the quantum-coherence many-body Kondo state, due to the possibility of continuous tuning the relevant parameters governing the properties of this state, in equilibrium and nonequilibrium situations. Recently Kondo effect has been studied in double quantum dot molecule in series. This system allows the study of the many body molecular Kondo states in equilibrium and nonequilibrium situation. The type of coupling between the quantum dots determines the character of the electronic states and the transport properties of the artificial molecule. In the tunneling regime, the electronics states are extended across the entire system and form a coherent state based on the bonding or anti-bonding levels of the quantum dots.
An alternative configuration consists of a side-coupled quantum dots attached to a perfect quantum wire (QW). This structure is reminiscent of T-shaped quantum wave guides known as electron stub tuners. In this case, the quantum dots acts as scattering centers in close analogy with the traditional Kondo effect.
Recent electron transport experiments showed that Kondo and Fano resonances occur simultaneously. Multiple scattering of traveling electronic waves on a localized magnetic state are crucial for a formation of both resonances. The condition for the Fano resonance is the existence of two scattering channels: a discrete level and a broad continuum band.
In this work we study the transport properties of a double quantum dot molecule side attached to a quantum wire in the Kondo regimen. We use the finite-U slave boson mean-field approach which was initially developed by Kotliar and Ruckenstein and used later by Bing Dong and X. L. Lei to study the transport through coupled double quantum dots connected to leads. We have found that the transmission spectrum shows a structure with two antiresonances localized at the bonding and antibonding energies of the quantum-dot molecule, and one resonance at the site energy of the outside quantum-dot. Moreover the density of states shows that the outside quantum-dot develops a strong Kondo effect with the quantum-wire and its Kondo temperature depends strongly on the interdot coupling tunneling. The linear conductance reflects the transmission spectrum properties as the gate potential is varied.

Alexander Ossipov (Germany/present ICTP)

"T-duality in the SUSY theory of disordered quantum systems"

Pedro Pereyra (Univ.Autonoma Metropolitana - Azcaputzalco, Mexico City)

Spin dynamics through homogeneous magnetic superlattices
P. Pereyra and J.L. Cardoso

We study the spin evolution through a homogeneous magnetic superlattice. We use the transfer-matrix approach to analyze the resonant band structure and to follow the spin tunneling process. Interesting features and spin transitions can be observed on the wave function's amplitude and phase along the superlattice. Clear signatures of coherent spin mixing and coherent spin flipping processes can be observed.

Interacting modes induced by transverse electric field in 2DEG
P. Pereyra and A. Anzaldo

We show here that a transverse electric field, as in field-effect devices, leads to interesting interfering phenomena in the electronic transport. Using the Sylvester Theorem for matrix-valued functions, we study the transmission properties of a multi-propagating modes (multichannel) quasi-two-dimensional electron gas in the presence of a channel mixing transverse electric field. We observe interesting resonant coupling effects, which explain the fundamentals of the giant superlattice-conductance as well as giant superlattice-resistance effects.

Maria T. Perez Maldonado (Univ. Havana, Cuba)

"Electron quasienergies in a semiconductor superlattice under an in-plane magnetic field and laser radiation"

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The availability of intense laser sources has made it possible to study a wide range of nonlinear phenomena in atoms, molecules, plasmas and solids under the action of intense electromagnetic radiation. These studies have been extended in the last decade to semiconductor heterostructures under intense electric fields, originated by an applied ac voltage or a high-intensity infrared laser. At frequencies of the order of 1 THz, typical of free-electron lasers, photon energies are comparable to the energy separation between electronic levels and heterostructures couple strongly to the electromagnetic field. A number of nonlinear phenomena such as collapse of minibands, multiphoton absorption, photon-assisted tunneling, dynamical electron localization, formation of electric field domains, negative absolute conductance, and negative differential resistivity have been observed, explained or predicted in these systems. We have previously shown that when an in-plane magnetic field is applied, these nonlinear effects appear in superlattices for lower radiation intensities, since the magnetic field introduces a new characteristic frequency (the cyclotron frequency) in the system under consideration, and an enhanced effect of the external electromagnetic field is expected near the resonance conditions. Additionally, the magnetic field couples the motion in the directions perpendicular to it and, therefore, a similar result should be observed for waves polarized in any direction perpendicular to the magnetic field. In this work we consider the motion of an electron in a semiconductor superlattice, undergoing the combined action of a static magnetic field perpendicular to the growth direction and intense electromagnetic radiation. Exact numerical solutions of the time-dependent Schrodinger equation are found. Quasienergies are calculated as function of the cyclotronic orbit center position for different values of the radiation intensity. The features of the resulting magnetic subbands are studied, and the occurrence of band suppression and dynamic localization is discussed. The results are compared with those previously calculated in the Kramers-Henneberger approximation.

Alexander P. Protogenov (RAS, Nizhny Novgorod, Russia)

"Toroid current states in doped antiferromagnetic insulators"

The free energy bounds for inhomogeneous current states in doped antiferromagnetic insulators and spatial configurations of spin and charge degrees of freedom in lightly and heavily underdoped phases of this strongly correlated electron system are considered. It is shown that states are characterized by a small parameter of geometric origin, which determines the degree of packing in the knots of filament many folds of the order parameter distributions.
We found a hierarchy of the spatial scales for flat knots, which gives rise to a free energy gain. A toroid moment in an underdoped state is found for thefirst time. It is shown that in the percolation picture of charge density distributions, that surround antiferromagnetic nanoclusters, the optimal level of the hole density is in qualitative agreement with the experimentally observed value.

Abdulla Rakhimov (Inst. Nuclear Physics, Tashkent, Uzbekistan)

Ginzburg Landau Theory Of Superconductivity: Beyond The Post Gaussian Approximation

The post Gaussian effective potential in $D=3$ and $D=2+2\veps$ are evaluated for the Ginzburg-Landau theory of superconductivity. It is shown that, the next order correction to the Gaussian approximation of the Ginzburg-Landau parameter κ is significant. This strongly indicates that strong correlation plays dominant role in high T_c superconductivity. In $D=2+2\veps$ fractal dimensions Ginzburg Landau parameter turned out to be sensitive to $\veps$ and the contribution of the post Gaussian term is larger than that for $D=3$. Adjusting $\veps$ to the recent experimental data on $\kappa (T)$ for high -T_c cuprate superconductor $Tl_2Ca_2Ba_2Cu_3O_{10} (T\cl-2223)$, we found that $\veps=0.21$ is the best choice for this material. These results clearly show that, in order to understand high - T_c superconductivity, it is necessary to include the fluctuation contribution as well as the contribution from the dimensionality of the sample. The method gives a theoretical tool to estimate the effective dimensionality of the samples.

Mark Rudner (MIT, Massachusetts, USA)

"Dynamic Polarization of Nuclear Spins in Quantum Dots"

Mark Rudner and Leonid Levitov, Massachusetts Institute of Technology

We investigate dynamic nuclear polarization produced by the hyperfine interaction in double quantum dot systems with spin-blocked electron transport. Under certain conditions, coupled quantum dots can be tuned to a so-called spin-blockade regime in which Pauli exclusion prevents electronic current from flowing through the double dot system in one direction. We consider the case of two dots where the following states are well separated in energy from all others: 1) one electron localized in the lowest spatial orbital of the second dot, 2) two electrons localized in the lowest spatial orbital of the second dot with singlet spin configuration, and 3) one electron localized in the lowest spatial orbital of each dot with either singlet or triplet spin configuration. We label these states by (0, 1), (0, 2)s, (1, 1)s and (1, 1)t, respectively. The numbers inside the parentheses indicate the number of electrons located on each dot, and the subscript specifies the singlet or triplet spin configuration. These conditions are motivated by the experiments of Tarucha et al. in which current is believed to flow via a 3-stage cycle: (0, 1) • (1, 1)s/t • (0, 2)s • (0, 1) ···. Spin-blockade occurs when the system occupies the spin-triplet state (1, 1)t at the second stage of the cycle. From this state, (0, 2)s cannot be reached without a spin-flip. Leakage current is due either to slow inelastic/cotunneling processes which avoid the (0, 2)s state completely, or to spin-flip processes arising from hyperfine or spin-orbit interactions that mix the (1, 1)t and (1, 1)s states.

In the case where the hyperfine interaction nearly resonantly couples the singlet and triplet states, we find that the spin-blockade is partially lifted and that the zero net-polarization nuclear spin state becomes unstable. At zero field, nuclear dipole-dipole interactions disorder the nuclear spins and prevent build up of polarization. At small applied field the longitudinal part of these interactions is quenched and dynamic polarization is possible. We study the nature and strength of this zero-polarization instability, and the dynamical behavior of the dynamical magnetic moment.

Funding for this work was provided by the DOE CSGF Program under grant number DEFG02-97ER25308

Nicholas Sedlmayr (Univ. Birmingham, U.K.)

"The tunneling density of states in a blockaded quantum dot"

We present a calculation of the tunneling density of states for a weakly coupled quantum dot. It is well known that at the degeneracy point in the Coulomb blockade regime the density of states in the dot is suppressed. However, following more careful analysis we find that this suppression is only partial. In a region of order the charging energy E_c centered on $\mu+eV_g$ the density of states is half the usual value instead of zero. Here V_g refers to the applied gate voltage tuned to one of the degeneracy points. Tuning the gate voltage away from this value we find the density of states is zero about $u+V_g$, as it was previously found to be.

Khaled Senouci (Univ. Mostaganem, Algeria)

" Nonlinear interactions effects on resonant states of Random Dimer Model"

It was well established two decades ago that all electronic states of one-dimensional (1D) disordered systems are exponentially localized in the absence of external fields irrespective of the amount of the disorder [1]. However, recently some models of disorder introducing the correlation [2,3] and the nonlinearity [4,5] have been shown to exhibit extended states at particular energies. These discrete extended states have been observed recently in the experiment with GaAs-AlxGa1-xAs random superlattices [6] and in nonlinear disordered media [7]. We use the Kronig–Penney model to study the effect of non-linear interaction on the transmissive properties of both disordered chains and random dimer model. In the disordered case, we found that the transmission decays as T~L-• around the band edge of thecorresponding periodic system. The exponent is independent of the strength of the nonlinearity in the case of disordered barrier potentials, while it varies with this strength for mixed potentials. In the case of chains with correlated disorder (Random Dimer Model), we found that the width of the resonances increase or decrease when the nonlinear interaction is introduced depending on its sign. We also found that this width has the same behaviour as a function of system length •E ~ 1/L1/2 as in the linear case.

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Nayana Shah (Univ. zu Koln, Cologne, Germany)

"Proposal for a two-channel quantum dot set-up: Predictions for the capacitance lineshape"

We propose a setup to realize two-channel Kondo physics using quantum dots. We discuss how the charge fluctuations on a small dot can be accessed by using a system of two single-electron transistors arranged in parallel. We derive a microscopic Hamiltonian description of the setup that allows us to make the connection with the two-channel Anderson model (of extended use in the context of heavy-fermion systems) and in turn make detailed predictions for the differential capacitance of the dot. Its line shape, which we determined precisely, shows a robust behavior that should be experimentally verifiable. Journal Ref: Phys. Rev. Lett. 95, 036801 (2005).

Razvan Teodorescu (Columbia Univ., USA)

" Dissipation and disorder effects in the discrete BCS model"

Igor Aleiner and Razvan Teodorescu

The algebro-geometric solution for the reduced BCS model describing small superconducting Al grains is investigated. The solution is derived using methods from the theory of integrable systems. Fluctuations of the spectrum induced by stochastic external fields are considered in the framework of random matrix theory. Incorporating the effects of these fluctuations through the averaging principle leads to a modified evolution equation, in general not integrable. Estimates for the relaxation time for the soliton-type solutions of Richardson-Gaudin models are computed.

Misha Turlakov (Columbia Univ., USA)

" Coulomb and tunneling effects in regular granular metal arrays"

Gonzalo Usaj (Centro Atomico Bariloche, Argentina)

" Tuning the non-local spin-spin interaction between quantum dots with a magnetic field"

We describe a device where the non-local spin-spin interaction between quantum dots (QDs) can be turned on and off with a small magnetic field [1]. The setup consists of two QDs at the edge of twotwo-dimensional electron gases (2DEGs). The QDs' spins are coupled through a RKKY-like interaction mediated by the electrons in the 2DEGs. A magnetic field B_z perpendicular to the plane of the 2DEG is used as a tuning parameter. When the cyclotron radius is commensurate with the interdot distance, the spin-spin interaction is setup allows for several dots to be coupled in a linear arrangement and it is not restricted to nearest-neighbors interaction. In addition, when spin-orbit coupling in the 2DEGs is included, the setup allows to dynamically change the \textit{symmetry} of the effective spin-spin Hamiltonian [2]. That is, the interaction can be changed from Ising-like to Heisenberg-like and vice versa.

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Emmanuel O. Yewande (Univ. Göttingen, Germany)

" Ripple motion in a simulated model of surface sputtering"

Recently the ripple-like nanostructures, that arise as a result of oblique incidence ion bombardment of solid surfaces, have been observed to propagate with a velocity that scales with the wavelength as $v \sim x^{-1.5}$ (1), whereas linear continuum theory predicts an exponenet of - 2(2). We study this ripple behaviour by means of a discrete Mnte CArlo model of the sputtering process (3). We found an exponent -2.18, in good agreement with the continuum thoery. In addition, we found that the ripple velocitydepends strongly on the temperature; and also vanishes ahead of the periodic ripple pattern at high effective temperatures (4).