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FRACTIONAL EXCLUSION STATISTICS – THE PARADIGM FOR THE DESCRIPTION OF SYSTEMS OF INTERACTING PARTICLES

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In the Landau's Fermi liquid theory a gas of interacting particles is described as an ideal gas of quasiparticles [1]. We shall present a critical analysis of this theory and show that the description is not accurate and leads to a number of thermodynamical and statistical contradictions. One such contradiction appears in the calculation of the specific heat.

We argue that the correct paradigm for the description of a gas of interacting particles in terms of ideal particles is provided by the concept of fractional exclusion statistics (FES) [2, 3]. The misleading feature that fueled the efforts to describe in general a gas of interacting particles only in terms of Bose or Fermi quasiparticles is the similarity that appears in some cases between some thermodynamic properties of gases of different exclusion statistics–a property which is called the "thermodynamic equivalence" [4].

The application of FES to general systems of interacting particles is based on some recent amendments made to the FES formalism [5, 6].

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ODD-FREQUENCY COOPER PAIRS IN SPIN-TRIPLET SUPERCONDUCTING PROXIMITY STRUCTURES

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Mysterious behavior of odd-frequency Cooper pairs is an intriguing issue in the physics of superconductivity and superfluidity. Unfortunately, the odd-frequency pairing state has never been yet detected experimentally in bulk materials. Odd-frequency Cooper pairs themselves, however, may exist in superconducting proximity structures. It was theoretically predicted in ferromagnet/superconductor junctions that spin-mixing due to spin-dependent potential should generate odd-frequency spin-triplet s-wave pairs. Manifestations of triplet pairs were recently observed experimentally as a long-range Josephson coupling across ferromagnets. An alternative way of creating odd-frequency pairs was suggested in proximity structures involving a normal metal attached to an odd-parity spin-triplet superconductor that belongs to the conventional even-frequency symmetry class. The parity-mixing due to inhomogeneity produces the odd-frequency pairs even in this case. Although the existence of odd-frequency Cooper pairs has been discussed in a number of theoretical studies, intrinsic phenomena of odd-frequency pairs are still open issue even now.

We have considered proximity effect in a dirty normal metal attached to a spin-triplet superconductor. In the presentation, we will discuss unusual physical phenomena in the normal metal due to the odd-frequency symmetry[1-4].

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PINNING OF AN ABRIKOSOV VORTEX ON A SMALL CYLINDRICAL CAVITY

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Type-II superconductors are known to have non-zero electrical resistivity in the mixed state, which appears due to viscous flux flow in the presence of a transport current. Vortex motion can be suppressed by the introduction of defects (pinning sites) capable to capture (pin) vortices. Thus, flux flow can be damped and the resistivity can be considerably decreased. It is known that columnar defects are the most effective pinning sites. Vortex pinning on such defects has been considered theoretically in a number of papers (see [1-3] and others).

Using the Ginzburg-Landau (GL) equation we investigated the interaction of a vortex with a small cylindrical cavity with the characteristic size of the cross-section much smaller than the coherence length. For a sufficiently small transport current the solution of the GL equation can be presented as the sum of the unperturbed vortex and a small perturbation, so the pinning force can be determined using a method similar to the one applied in the paper [4]. We found that for currents below the depinning threshold a bound state may form, where the vortex core is outside the defect. It has been proved that the problem of the pinning potential calculation is reduced to an exterior Neumann problem for Laplace's equation. We determined the pinning potential for a cavity with an elliptic cross-section and the depinning current for a circular cavity.

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ENHANCEMENT OF SUPERCONDUCTIVITY BY ANDERSON LOCALIZATION

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Influence of disorder on the temperature of superconducting transition (Tc) is studied within the σ-model renormalization group framework. Electron-electron interaction in particle-hole and Cooper channels is taken into account and assumed to be short-range. Two-dimensional systems in the weak localization and antilocalization regime, as well as systems near mobility edge are considered. It is shown that in all these regimes Anderson localization leads to strong enhancement of Tc related to the multifractality of wave functions. Screening of the long-range Coulomb interaction thus opens a promising direction for searching novel materials for high-Tc superconductivity. Details can be found in Ref. [1].

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ELECTRON-ELECTRON INTERACTIONS IN A SINGLE HIGHLY DOPED HETEROJUNCTION

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Starting from the pioneering works [1] and up to present time [2] the electron – electron (e-e) interactions are the subject of ever growing interest because of their fundamental role in kinetic phenomena. Among others, one should note the hot electron effects, quantum corrections to the conductivity, and damping (destruction) of Landau quantization in bulk and two-dimensional semiconductors with degenerate electrons. Also known are the anomalies in the low-temperature magnetotransport arising when 2D electrons fill several size-quantized subbands. In the present paper we report the results of the study of the e-e relaxation processes in a system of highly degenerate 2D electrons with the fine structure of energy spectrum and the electron density spatial distribution. Expressions are derived for the times of electron-electron intra- and intersubband interaction, matrix elements of the full screening potential and dynamic dielectric function in a 2D electron system.

Electron-electron interactions in a single highly doped heterojunction $Al_xGa_{1-x}/GaAs$ are considered taking both intra- and intersubband transitions. Characteristic features of 2D electron systems, such as the amplitude-frequency modulation, beatings and sharp bends in the oscillation amplitude magnetic field dependence make the description of Landau quantization damping in terms of the Dingle temperature rather problematic [2]. Another point to be pointed out is the fact that in the magnetic field range where a strong amplitude-frequency modulation take place the perturbed – subband electrons are in the state closed to the quantum limit and one can speak of the oscillations period in a rather limited sense.

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SURFACE IMPEDANCE OF SUPERCONDUCTORS WITH WEAK MAGNETIC IMPURITIES

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Magnetic impurities affect the spectrum of excitations of a superconductor and thus influence its impedance. We concentrate on the dissipative part of the surface impedance. We investigate its dependence on frequency, the density and strength of magnetic impurities, and the density and temperature of quasiparticles. Even a small concentration of weak magnetic impurities significantly modifies the excitation spectrum in the vicinity of the BCS gap. Therefore, we give special attention to the absorption threshold behavior at zero temperature and to the low-frequency absorption by quasiparticles. The discrete energy states introduced at low density of magnetic impurities may serve as traps for nonequilibrium quasiparticles, reducing the absorption in some range of low radiation frequencies.

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D-WAVE RESONANT SCATTERING IN ATOMIC TRAPS

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Higher partial-wave interactions (with $l \geq 1$) represent an intriguing perspective in research of ultracold gases and are expected to provide novel many-body phenomena, such as unconventional superfluidity and superconductivity [1, 2, 3]. However, to create considerable interactions with $l \geq 1$ in ultracold regime, even in resonant case, is very challenging experimental task due to the strong centrifugal narrowing of the shape resonances.

We have suggested a novel mechanism for enhancement of the resonant d-wave interatomic interactions in harmonic waiveguides [4, 5]. It was shown that the ultracold scattering can be continuously tuned from s-wave to d-wave resonant behavior with considerable width by tuning the trap frequency $\omega_\perp$ due to the strong coupling $\frac{1}{2}\mu\omega_\perp^2\rho^2 = \frac{1}{6}\mu\omega_\perp^2 r^2[2P_0(\cos\theta) - P_0(\cos\theta)]$ between the s- and d-waves induced by the atomic interaction with the trap. The transformation of a 3D d-wave shape resonance to the d-wave resonance in the quasi-1D regime was analyzed and a scaling relation for the resonant position was found. The effect can be utilized for the realization of ultracold atomic gases interacting via higher partial-waves and opens a novel possibility for studying strongly correlated atomic systems beyond s-wave physics. **References**

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MANIPULATION OF MAJORANA FERMIONS IN SUPERCONDUCTING VORTEX STATE

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A vortex in a model spinless chiral p-wave superconductor induces two Majorana fermions (MFs), one in the core and the other at the sample edge. In the present work, we show that the edge MFs can be generated, fused, transported, and braided easily by tuning gate voltages at point-like constriction junctions between samples, while the core MFs are fixed. Solving the time-dependent Bogoliubov-de Gennes equation, we demonstrate that the braiding of edge MFs obeys the non-Abelian statistics. The present setup is therefore a promising implementation for topological quantum computation, and has the advantage of easy manipulation and simple device structure.

This work is a collaboration with Q. –F. Liang and Z. Wang. It has been supported by WPI Initiative on Materials Nanoarchitectonics, MEXT, Japan, and Grants-in-Aid for Scientific Research (No.22540377), JSPS, and partially by CREST, JST.

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SUPERCONDUCTING MULTI-QUBIT SYSTEMS: TOWARDS QUANTUM METAMATERIALS

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We investigated microwave properties of superconducting multi-qubit systems. In the first set of experiments a frequency-selective readout for an array of 7 flux qubits has been demonstrated. Each qubit is located in its own λ/4 resonator. The resonators with slightly different resonant frequencies are coupled to a single high-frequency transmission line. Using just one cold amplifier we performed spectroscopy of all qubits and determined their parameters in situ. In the second set of experiments we studied the propagation of the microwave power through a transmission line, formed by superconducting flux qubits inside a superconducting resonator. Obtained results are discussed.

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THEORY OF SCANNING TUNNELING SPECTROSCOPY OF THIN FILMS

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Scanning tunneling microscopes (STM) have been widely used for the study of various small-sized objects: islands, quantum wedges, thin films deposited on bulk substrates. Despite detailed experimental results have been obtained, a microscopic theory for STM tunneling spectra on samples of finite size has not been reported, which provides the motivation for the present work. In Ref.[1] the theory of STM was introduced by the model, in which a three dimensional STM tip is replaced by an inhomogeneous barrier in an otherwise nonconducting interface that separates the two conductors. It was shown that under assumption of small transparency of the tunnel barrier the wave function (thus the current-voltage characteristics) can be found analytically for an arbitrary size of the tunnel area. We applied this theory to the system which consists of a contact, having a radius smaller than the Fermi wave length, on the surface of a thin metal film, in which the energy spectrum is quantized along the direction perpendicular to the surface of the film.

In our work we present the tunnel current I(V) and differential conductance G(V) for small contacts, having a radius smaller than the Fermi wave length. The results obtained show that even in Ohm's-law approximation at eV=0, the conductance G(0) is not simply proportional to the electron density of states (DOS) in the isolated film. Such dependence is the result of point-contact geometry. Furthermore, the quantizetion of the electron energy spectrum in the film leads to a sawtooth dependence of differential conductance G(V) as a function of applied bias V and show that the distance between neighboring jumps in eV is equal to the distance between neighboring energy levels of size quantization. Thus, such method can be used for a spectroscopy of size quantized energy levels below and under the Fermi surface.

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PROXIMITY-INDUCED SUPERCONDUCTIVITY IN TWO-DIMENSIONAL ELECTRONIC SYSTEMS

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The approach applicable for spatially inhomogeneous and time-dependent problems associated with the induced superconductivity in low-dimensional electronic systems is developed. This approach is based on the Fano-Anderson model which describes the decay of a resonance state coupled to a continuum. We consider two types of junctions made of a ballistic two-dimensional electron gas placed in a tunnel finite-length contact with a bulk superconducting lead. We calculate the spectrum of the bound states, supercurrent, and the current-voltage curve which show a rich structure due to the presence of induced gap and dimensional quantization.

ELECTRONIC PROPERTIES OF DIAMANTINE IN THE SYSTEM OF ELECTRODE/DIAMANTINE/ELECTRODE: DFT NUMERICAL STUDY

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In this work we present our study on the electronic properties of diamantine and two other artificial molecules (DIM•As•Al) sandwiched between Au(111)electrodes. Using DFT and (OpenMX) package we calculate the electronic density of states and transmission probability of the pure and doped system. Our calculations show that the presence of impurity in Diamantine has significant effect on the energy gap which provides promising grounds for designing Diamondoid–based molecular devices (Figure 1,2).

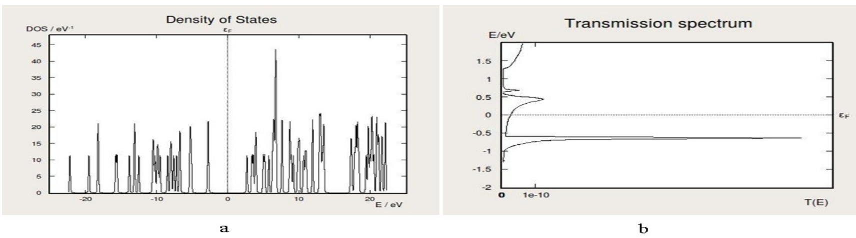

Figure 1 Pure Diamantine

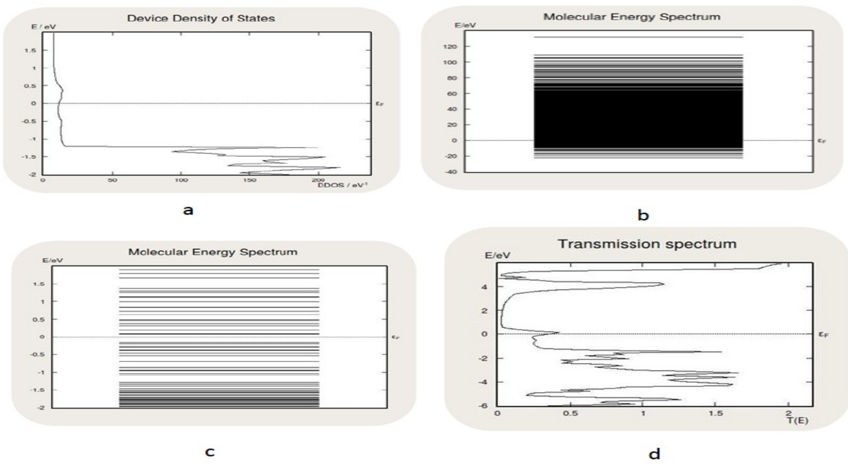

Figure 2: Al-As doped Diamantine

REMARKABLE ROLE OF INTERFACIAL THICKNESS ON ENERGETICS AND TRANSPORT IN A PERPENDICULAR MAGNETIC FIELD: A ONE-ELECTRON AND A ONE-COMPOSITE FERMION APPROACH

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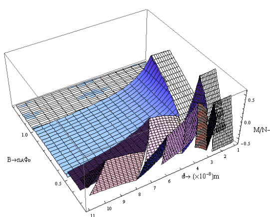
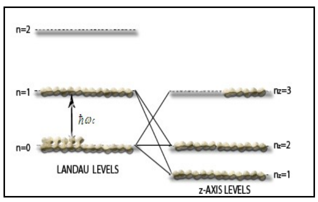
A systematic study is presented with analytical calculations based on a Landau Level (LL) picture for a many-electron system moving in an interface (or in a film configuration) and in the presence of a uniform and perpendicular magnetic field B, by seriously taking into account the finite thickness (**d**) of the Quantum Well (QW)) in the direction parallel to the field. It leads to a sequence of previously unnoticed singular features in global magnetization (**M**) and magnetic susceptibility that give rise to nontrivial corrections to the standard de Haas-van Alphen periods. Additional features due to Zeeman splitting are also reported in the full three-dimensional limit (such as certain energy minima that originate from the interplay of QW, Zeeman and LL Physics), that might be useful for the design of stable quantum devices. A corresponding calculation in a Composite Fermion picture demonstrates the usefulness of our LL + QW approach: it leads to new predictions on magnetic response properties of a fully-interacting electron liquid in an interface with nonzero thickness, exhibiting a richer and more delicate structure than the mere monotonic reduction of gaps with thickness reported long ago. By way of comparison, exact solutions are also independently derived for a fully three-dimensional system in a uniform magnetic field in the thermodynamic limit (a system mostly discussed in astrophysical applications); we find Hurwitz zeta functions playing an important role on all thermodynamic properties in ways that have not been earlier reported in the literature. Issues of transport for all the above systems are also discussed (with the interfacial thickness always being the central parameter) by addressing both cases of Quantum Charge- and Spin-Hall states.

Figures: **a)** **b)**





(a) **M** under combined variation of **B** and **d**; (b) energetic competition between LLs and QWs as an example of a sequence of nonintegrable patterns.

TUNNELING AND TRANSPORT DYNAMICS OF BOSE-EINSTEIN CONDENSATES

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Nowadays the trapped Bose-Einstein condensate (BEC) is widely recognized as a source of a new fascinating physics (see e.g. monographs [1]), characterized by numerous crossovers with other areas, including physics of nanosystems. As a particular example, we consider tunneling and transport dynamics of Bose-Einstein condensate in a double-well trap, with the accent to nonlinear effects caused by the interaction between BEC atoms. The numerical analysis is done within the 3D time-dependent Gross-Pitaevskii equation.

The main regimes of tunneling dynamics (Josephson oscillations and macroscopic quantum self-trapping) are scrutinized in the weak and strong coupling limits. The optimal protocols of BEC transport between the wells are proposed [2]. The protocols are robust even at a strong non-linearity. The transport is driven by time-dependent monitoring the coupling between the wells (barrier penetrability) and their relative bias. Finally, the perspectives of tunneling and transport dynamics (crossover with Josephson effects in superconductors and nanosystems, optimal control, shortcuts to adiabaticiy, etc) are briefly discussed.

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BOUND STATES FOR BENT AND BRANCHING CHAIN-TYPE NANOSTRUCTURES

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Quantum graph is widely used mathematical model for nanosystems (see, e.g., [1- 3]). From physical point of view spectral and transport properties of the system is the most interesting. As for star-like graph, it is rather simple and doesnt give us rich spectrum. The situation changes when one considers a decorated graph or graph with loops, especially, noncompact one. For this system there is an intriguing question about bound state existence. First, consider the periodic chain of coupled rings connected through their touching points. The corresponding Schrodinger operator has

infinitely degenerate eigenvalues and absolutely continuous spectrum. The bent chain of rings is also studied by Exner. In this case the discrete spectrum (i.e. bound states) appears. This system is, in some sense, a model of bent quantum waveguide. An advantage of the quantum graph model is its one-dimensionality. It allows one to get the spectral equation in an explicit form. Another advantage is the possibility to use the transfer matrix approach to derive the spectral equation. In the present paper we consider another modification of the chain graph Y-type branching graph with branches coupled to a basic ring. The method of the transfer matrix is used. We obtain the spectral equation, and study the discrete spectrum of the corresponding Schrodinger operator. The dependence of the eigenvalues positions on the branching angle is investigated.

Also we deal with spectral problems for more complicated systems. Quantum graph of graphen-like Y-branching strips is considered in a way analogous to that for branching chains of rings. The transfer matrix approach is used. Bent and branching chains of three-dimensional resonators coupled through small windows are investtigated. The model is based on the theory of self-adjoint extensions of symmetric operators. The point and the continuous spectrum for the systems is studied.

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BOUND STATES OF TWO-PARTICLE HAMILTONIAN FOR LOCALLY PERTURBED NANOLAYERS

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It is known that curved quantum layers can store particles. From mathematical point of view it is related with the existence of eigenvalues of the corresponding Hamiltonian. The increase of curvature leads to increasing of the eigenvalues number.

This question is important in various physical problems. For example, to do two-qubit operation in quantum computer based on coupled quantum waveguides (see, e.g., [1] it is necessary to store two electrons in some bounded domain during the operation time.

Another interesting application is related with the storage of hydrogen (or protons) in nanolayered structures. It can give effective and safe fuel container for hydrogen engine. One can note that layers with curved boundaries are more effective for particles storage because the increasing of the curvature (or boundary perturbation amplitude) leads to increasing of the discrete spectrum cardinality. Hence, the amount of the hydrogen stored in the layered structure will be greater. Note that the Hamiltonian for the corresponding plane layered structure has empty discrete spectrum.

Local deformations of the nanolayers leads to appearance of eigenvalues of the corresponding one-particle Hamiltonian. The cardinality of the discrete spectrum was used to estimate the maximal number of non-interacting fermions stored in the nanolayers [2]. The discrete spectrum of the Hamiltonian of two interacting particles is considered. Relation between the system parameters (interaction intensity - waveguide deformation) ensuring the existence of non-empty discrete spectrum is studied.

Hartree approximation and Finite Elements Method are used. We consider three different types of layers perturbations: deformation of layer boundary, curved layer (bent waveguide), two layers coupled through small window. The efficiencies of particles storage in these systems are compared. It is shown that window coupled layers are the most appropriate. **References**

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SOLITON SOLUTION OF GENERALIZED JAYNES-CUMMINGS MODEL FOR MANY PARTICLE SYSTEMS

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The work is devoted to investigations dynamics of system of two-level particle interacting with a field, i.e. system is an analogical to system in Jaynes-Cummings model (JCM) [1]. It is well known that in JCM, system consisting of single two-level particle interacting with a single photon is considered. As opposed to this model in the present work, system consisting of multi two-level particles interacting with multi photons is investigated. Dynamics of this system is described by means of generalized kinetic equation [2]. In the work, the condition is determined under which solution of generalized kinetic equation is reduced to the solution of nonlinear Schrödinger equation.

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ON THE VIBRON DRESSING IN BEADED HYDROGEN BONDED CHAINS

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In this research we analyze the dressing effect for the single vibron states in beaded hydrogen bonded macromolecule structures. In order to derive small–polaron picture, we use modified Lang–Firsov unitary transformation [1, 2]. Obtained results are compared with those ones predicted by the standard small–polaron theory [3,4,5]. It is shown that the influence of the vibron dressing in one direction on the vibron dressing in other direction (and vice versa) is significant, and can not be neglected.

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ZERO-FREQUENCY NOISE IN ADIABATICALLY DRIVEN QUANTUM SYSTEMS

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We are interested in electronic transport through mesoscopic devices due to a time-dependent modulation of certain system parameters. A famous example is charge pumping in the absence of bias[1]. In addition, also the noise created due to the pumping process is of vital importance [2]. We investigate the zero-frequency noise power, defned as

$$S_{\alpha\beta} = \int_0^\tau \frac{dt}{\tau} \int_{-\infty}^{\infty} dt' \left\langle \delta I_\alpha(t)\delta I_\beta(t-t') + \delta I_\beta(t-t')\delta I_\alpha(t) \right\rangle \qquad (1)$$

for adiabatic quantum pumps, driven periodically with period $\tau = 2\pi/\Omega$, where Ω is the driving frequency. We defined $\delta I_\alpha = I_\alpha - \langle I_\alpha \rangle$ as the deviation from the expectation value of the current from contact α. In small quantum systems, Coulomb interacttion between electrons on the dot is crucial. For this purpose, we make use of a real-time non-equilibrium diagrammatic approach within a perturbative expansion in the tunnel coupling to the reservoirs and extend a treatment of the explicit time dependence of the Hamiltonian [3] to the calculation of current noise [4]. As a generic example, we consider the case of a single-level quantum dot coupled to two electronic reservoirs, where charge pumping arises by applying two out-of-phase time-dependent parameters, such as the energy levels, the bias or the tunnel couplings. The current (and all other observables) can be written as

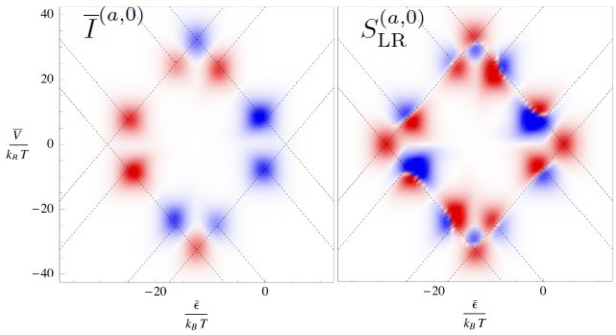

Fig.1. Density plot of the pumped charge $\bar{I}^{(\alpha,0)}$ and the adiabatic noise $S_{LR}^{(\alpha,0)}$ as a function of the mean energy level $\bar{\epsilon}$ and the mean bias voltage $\bar{V}$. The underlined dashed grid sketches the dot level resonance lines.

$I(t) = I^{(i)}(t) + I^{(a)}(t)$ where the instantaneous part $I^{(i)}$ depends on the parameters frozen at time t only, whereas $I^{(a)}$ is a correction in first order of that accounts for a slight lagging behind of the system.

We find that the instantaneous noise coincides with the stationary expressions, found in Ref. 4, but in a time-averaged fashion. In the case of zero external bias, the instantaneous noise fulfills a time-averaged uctuation dissipation theorem

$$S_{LR}^{(i)} = -4k_B T \int_0^\tau \frac{dt}{\tau} G^{(i)}(t) , \quad S_{LR}^{(\alpha,0)} = -4k_B T \int_0^\tau \frac{dt}{\tau} G^{(\alpha,0)}(t) + S_{LR}^{corr} \quad (2)$$

with the thermal energy $k_B T$ and the instantaneous (adiabatic) linear conductance $G^{(i,\alpha)}(t) = \frac{\partial}{\partial V} I^{(i,\alpha)}(t)\Big|_{V=0}$ We have confirmed this result up to second order in the tunneling rate Γ . The adiabatic correction on the other hand shows already in leading order in Γ , that the pumping noise in general does not fulfill a similar relation and instead contains a Coulomb interaction-induced correction term S_{LR}^{corr} i.e., $S_{LR}^{corr} = 0$ if the interaction is zero.

We also consider adiabatic transport in the presence of an additional time-dependent bias voltage, which - together with the gate voltage modulation - defines a pumping scheme that is interesting for spectroscopic purposes[5]. We find that there can be pumping noise even if there is zero pumped charge, see Fig. 1. The pumping noise distinguishes whether there is an active pump (the system e_ectively feels two parameters), irrespective of whether the time-averaged current is cancelled out or not. Therefore the pumping noise contains crucial information about the pumping process that cannot be retrieved by measuring solely the pumped charge [6].

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ORDER FROM DISORDER: SPIN AND CHARGE TRANSPORT IN SYSTEMS WITH NANOSCALE RANDOM SPIN-ORBIT COUPLING

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Spin-orbit coupling in solids is strongly sensitive to the system parameters. As a result, any disorder causes a random spin-orbit field. We consider spin and charge transport resulting from such a random spin-orbit coupling in low-dimensional electron systems [1]. These effects are important for semiconductor quantum wells, electrons at surfaces, nanowires, and graphene. The spatial scale of the randomness is system-dependent being on the order of 10 nm typically. This randomness leads to spin- and additional momentum relaxation, which we consider in the classical and quantum regimes. The corresponding relaxation rates determine the variety of process in these systems. We begin with the spin dynamics in nanowires and show that a spin memory in the random field leads to anomalous low-frequency spin noise. In addition, we show that an efficient spin injection is possible due to random spin-orbit coupling. In transport phenomena, the random spin-orbit fields lead to a spin-Hall effect robust to the disorder. This coupling also causes charge currents due to the anomalous Hall effect with a strongly non-monotonous dependence of conductivity on the magnetization. Another manifestation is a strong negative magnetoresistance with the physical mechanism different from those presently known.

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BOSE-EINSTEIN CONDENSATION OF LONG-LIFETIME POLARITONS

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In microcavity structures, the photon states and exciton states can be brought into resonance, leading to new mixed states known as polaritons with properties of both. The polaritons can be thought of as photons dressed with mass and with mutual interactions; the polariton gas is a weakly interacting Bose gas that can undergo condensation. In the first part of this talk I will review past experiments showing many effects similar to condensates of cold atom gases. One limitation of these experiments has been the short lifetime of the particles compared to their thermalization time. In the second part of this talk I will present the results of new experiments with polaritons in high-Q cavities that have much longer lifetime (Q of around a million, with cavity lifetime of around 100 ps). We see, among others things, long-range transport of the particles, up to a millimeter, and a very sharp threshold for the condensation.

STATISTICAL APPROACH TO THE TWO-LEVEL ATOM-FIELD SYSTEM

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In the work, the solution of generalized kinetic equation (GKE) describing dynamics system of two-level particle interacting with photon is defined by means of method of offered by N.N. Bogolubov and N.N. (Jr.) Bogolubov [1]. The present system is an analogical system in Jaynes-Cummings model (JCM) [2]. It is well known that in JCM, system consisting of single two-level particle interacting with a single photon is considered. As opposed to this model in the present work, system consisting of multi two-level particles interacting with multi photons is investigated. Moreover, in the work in terms of obtained solution of GKE, intensity of emitting and absorption photons are determined.

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TRIPLET SUPERCONDUCTIVITY IN A FERROMAGNETIC VORTEX

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We argue that odd-frequency triplet superconductivity can be conveniently realized in hybrid superconductor-ferromagnet (SF) structures with a ferromagnetic vortex. We demonstrate that due to proximity-induced long-range triplet pairing such SFS junctions can sustain appreciable supercurrent which can be directly measured in experiments. Depending on the contact geometry either zero or π-junction regime can be realized in the system under consideration.

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