Titles and abstracts

1. R. Ben Saad (Tunis)

   Title: "Mourre approach to the Landaeur-Buttiker formalism"

   Abstract We consider a small system $\mathcal{S}$ with a finite number of degrees of freedom, which interacts with several extended ideals reservoirs $\mathcal{R}_1, \dots, \mathcal{R}_M$. At time $t = 0$ these reservoirs are in thermal equilibrium at inverse temperature $\beta_1, \dots, \beta_M$. If these parameters do not all take the same value, as $t \to \infty$ the coupled system $\mathcal{S} + \mathcal{R}_1 + \dots + \mathcal{R}_M$ approaches a non equilibrium steady state (NESS) which carries no trivials currents. For the construction of NESS, we use the $C^\star$-scattering approach proposed by Ruelle. In this work we consider coherent electronic transport in the independent electrons approximation. Our aim is to show that the Landaeur-Büttiker formalism used in the physics litterature to deal which this class of models is a special instance of Ruelle scattering theory. This approach allows us to obtain an explicit formula for the NESS, using this formula we shall derive the Landaeur-Buttiker formula which expresses the steady currents flowing through a sample in terms of scattering data of this sample. To obtain such results, we use a time dependent approach based on the Mourre estimates.

2. H. Cornean (Aalborg)

   Title: "Trions and biexcitons in quasi one-dimensional systems"

   Abstract: In order to characterize the spectral and transport properties of large many-body systems, one uses some simpler effective models which are supposed to reproduce the main features of the real thing. For instance, the true many-body excited states of an electron gas in a carbon nanotube can be modeled as bound states of a four-body effective operator. We will study the influence of low dimensionality on the nature of these bound states.

3. T. Dorlas (Dublin)

   Titre: "Quantum Information and Computing"

   Abstract: A simple survey of quantum computing and information theory for those who are not familiar with the subject. I shall try to cover some of the basics of quantum computing including theory and some of the proposed physical realisations, and also some basic quantum information theory, including quantum channels and elementary cryptography.

4. P. Exner (Prague)

   Title: "Approximation of nontrivial quantum graphs by Schrödinger operators on Neumann networks"

   Abstract: It is a longstanding problem how to understand the coupling in vertices of a quantum graph using an approximation by a family of appropriate "fat graphs". In particular, it is known that if the approximating operators are Laplacians, the squeezing limit yields only the free (or Kirchhoff) boundary conditions. In this talk we report a recent result coming from a common work with Olaf Post: it will be shown that adding families of suitably scaled potentials one can get spectrally nontrivial vertex couplings, including those with wave functions discontinuous at the vertices.

5. V.I. Falko (Lancaster) Department of Physics, Lancaster University, Lancaster, LA1 4YB, UK

   Title: "Quantum transport in disordered graphene structures"

   Weak localisation of electrons in weakly disordered graphene was studied in the regime of high carrier densities. The proposed theory includes symmetry classification of disorder in monolayer (and bilayer [2]) graphene, analysis of the role of trigonal warping in the band structure, bond disorder, sublattice asymmetry and the intervalley scattering. Weak localisation magnetoresistance in graphene has been observed in a number of experiments, and we show that this can be used to extract information about, e.g., intervalley scattering in graphene samples. By analysing universal conductance fluctuations in graphene nanostructures [3] we show how the correlation function of conductance fluctuations can be used to deternine temperature of electrons in graphene [4] (which may strongly differ from the thermal bath temperature due to a poor heat contact with the electrodes/substrate).

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   [2] K. Kechedzhi, V. Falko, E. McCann, and B. Altshuler, Phys. Rev. Lett. 98, 176806 (2007)

   [3] K. Kechedzhi, O. Kashuba, and V. Falko, Phys. Rev. B 77, 193403 (2008)

   [4] K. Kechedzhi, D. Horsell, F. Tikhonenko, A. Savchenko, R. Gorbachev, I. Lerner, and V. Falko - arXiv:0808.3211

6. F. Méhats (Rennes)

   Title: "Effective mass approximation for a bidimensional electron gas in a strong magnetic field"

   Abstract: We derive an asymptotic model for the transport of an electron gas subject to the competitive effects of a strong potential confining in a plane, a strong magnetic field in this plane, and selfconsistent Coulombian interactions. To this aim, we analyze the limit of a singularly perturbed Schrodinger-Poisson model. The limit system takes the form of a bidimensional Schrodinger equation with anisotropic masses, coupled to a Poisson equation with a modified kernel, that keeps track of the third dimension.

7. H. Neidhardt (WIAS Berlin)

   Title: " Kohn-Sham systems at zero temperature"

   An one-dimensional Kohn-Sham system for spin particles is considered which effectively describes semiconductor nanostructures and which is investigated at zero temperature. We prove the existence of solutions and derive a priori estimates. For this purpose we find estimates for eigenvalues of the Schrodinger operator with effective Kohn-Sham potential and obtain $W^{1,2}$-bounds of the associated particle density operator. Afterwards, compactness and continuity results allow to apply Schauders fixed point theorem. In case of vanishing exchange-correlation potential uniqueness is shown by monotonicity arguments. Finally, we investigate the behavior of the system if the temperature approaches zero. Joint work with H. Cornean (Aalborg); H. Hoke, P.N. Racec, J. Rehberg (Berlin)

8. T. Pedersen (Aalborg)

   Title: "Linear and Nonlinear Optical Properties of Carbon Nanotubes"

   Carbon nanotubes provide a rich playground for studies of the optical properties of low dimensional structures. They can be both metallic and semiconducting and the energy band structure can be tuned via the geometry. In semiconducting nanotubes, many-body effects have a huge effect on the optical response. Excitons and other complexes (biexcitons, trions etc.) are highly stable and modify the single-particle response significantly. In this talk, the stability of electron-hole complexes is reviewed and their signatures in linear and nonlinear optical spectroscopy are discussed. Novel results for optical second harmonic generation in the independent-particle limit are presented and the possible role of excitons in this case is considered.

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9. F. Peeters (Anvers)

   Title Graphene superlattices

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   Carbon forms many allotropes of which graphite and diamond are known from ancient times and several new ones (fullerenes, nanotubes) were discovered only in the last 20 years. The two-dimensional form, called graphene, was only very recently fabricated [1]. Electrons in graphene obey a neutrino-like linear energy dispersion that has resulted in the observation of a number of peculiar electronic properties, e.g. anomalous quantum Hall effect, absence of localization and minimal conductivity. New unusual behavior is found if such electrons are subject to a periodic potential [2]. As for normal electrons in a superlattice the propagation of charge carriers is highly anisotropic. In contrast to the case for normal electrons we find that the easy direction of propagation is now in the direction of the superlattice where the energy dispersion is almost not influenced by the superlattice potential while parallel to the superlattice the bands can become very flat [2.4]. This unusual behavior is related to the Klein paradox [3] and can be used to collimate electron beams [5]. These results will be contrasted with those in bilayers of graphene where the electron dispersion near the Dirac point is parabolic. I will show that magnetic barriers have a very different effect on such effective zero mass electrons. New quantum bound states are found that are localized near the barrier edge and propagating parallel to this edge [6]. Such barriers can be used to construct a direction dependent wave vector filter.

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10. C.A. Pillet (Marseille)

    Title: "Spectral analysis of a CP map and thermal relaxation of a QED cavity"

    Abstract: I will present the results of a recent joint work with L. Bruneau (Cergy) concerning the thermal relaxation of a QED cavity under repeated interactions with atoms (a so called one-atom maser). The main points of this work are: (i) to study return to equilibrium for some open system with infinite dimensional Hilbert space (results in this direction are scarce); (ii) to show that, using an appropriate version of Perron-Froebenius theory (due to Scrader), one can obtain interesting information on the spectrum of completely positive (CP) maps which can be turned into ergodic properties of the semigroup generated by this map.

11. R. Purice (Bucarest)

    Title: "NESS as adiabatic limit on the potential bias"

    We consider the problem of two conducting wires connected by a small sample on which we adiabatically switch-on an electric potential byas, starting at time $-\infty$. We suppose the system at equilibrium at time $t \to -\infty$ at a temperature T. We prove that the state at time t=0 has an adiabatic limit that we explicitely give. This is the result of a collaboration with H. Cornean, P. Duclos and G. Nenciu.

12. P. Racec (Berlin)

    Title: "Modeling of quantum transport in cylindrical nanowire heterostructures"

    Abstract: We calculate the current scattering matrix for non-interacting electrons scattered in a cylindrical nanowire. The rotational symmetry allows for a reduction of the scattering problem to a two-dimensional one, which we solve it using the R-matrix formalism. This formalism allows for an efficient computation of the resonances, as poles of the S-matrix, and also for the computation of the scattering wave functions inside the scattering region. The numerical results are presented for a cylindrical nanowire with embedded double barriers.

This is a joint work with Roxana Racec (BTU Cottbus, Germany) and Hagen Neidhardt (WIAS Berlin, Germany).

13. V. Zagrebnov (Marseille)

    Title: "Mean-Field Interacting Boson Random Point Precesses in a Weak Traps"

    Abstract: A model of the mean-field interacting boson gas trapped by a weak harmonic potential is considered as a boson random point processes. We prove that in the Weak Harmonic Trap (WHT) limit there are two phases distinguished by the boson condensation and by a different behaviour of the local particle density. For chemical potentials less than a certain critical value, the resulting Random Point Field (RPF) coincides with the usual boson RPF, which corresponds to a non-interacting (ideal) boson gas. For the chemical potentials greater than the critical value, the boson RPF describes a divergent (local) density, which is due to *localization* of the macroscopic number of condensed particles. Notice that it is this kind of transition that observed in experiments producing the Bose-Einstein Condensation in traps.

    (Based on the common paper with Hiroshi TAMURA (Kanazawa))