MP 13: Poster (permanent Mo-Do)

Time: Tuesday 8:00–18:00 Location: SPA Foyer

MP 13.1 Tue 8:00 SPA Foyer

Dynamics of the quantum kicked oscillator coupled to a heat bath — •Pablo Carlos López Vázquez[1] and Thomas Gorin[2] — [1]Max Planck Insititute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany — [2]Departamento de Física, Universidad de Guadalajara, Blvd. Marcelino García Barragán y Calzada Olimpica, 44840 Guadalajara, México

The problem of a two-level system coupled to a generic chaotic environment which is in turn coupled to a heat bath, has been studied by Gorin et al. In this study, they have used a random matrix description of the environment. They have observed the recovery of the coherence of the two-level system when the coupling between the random matrix model and the heat bath is increased. However, the results of this study were of limited physical value due to the restrictive approximations necessary in random matrix theory.

A more realistic description for this dynamics is presented in this work. Here, the environment is replaced by quantum kicked oscillator in contact with a heat bath. We show that in this model, the coherence of the two level system is also recovered, when the coupling between the kicked oscillator and the heat bath is increased.

In order to obtain a better understanding of these phenomena, we focus on the dynamics of the kicked oscillator coupled to a heat bath in the phase-space representation.

Finally, we explore the possibility of obtaining a final quasi-stationary state of the oscillator, despite of the non-equilibrium created by the kicks.

MP 13.2 Tue 8:00 SPA Foyer

On the quantization of the electromagnetic flux — •Enderalp Yakaboylu and Karen Z. Hatsagortsyan — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg,Germany

The complete description of a gauge theory can be constructed via the Wilson line. This leads to a path-dependent formulation of gauge theory, which replaces the gauge freedom of the theory with the path freedom. It is shown that this equivalent formulation of gauge theory can provide a very simple and geometric description of the electromagnetic flux quantization. The developed formalism is employed for a (1+1) dimensional spacetime in order to discuss electric charge quantization [1].

[1] E. Yakaboylu, and K. Z. Hatsagortsyan, preprint arXiv:1309.0715

MP 13.3 Tue 8:00 SPA Foyer

Ab initio calculations of f-element compounds and solids with DFT+U method — •George Beridze[1], Ariadna Blanca-Romero[1,2], Yan Li[1], and Piotr Kowalski[1] — [1]Institute of Energy and Climate Research, Nuclear Waste Management and Reactor Safety, Forschungszentrum J\"ulich, Wilhelm-Johnen-Straße, 52428, J\"ulich, Germany — [2]Department of Chemistry, Imperial College London, London, United Kingdom

Safe storage of nuclear waste is a tough challenge facing today's society. It requires a deep understanding of chemistry and physics of complicated radionuclide-bearing systems. Nowadays, computational modelling is used alongside experiments to simulate behavior of these complex materials. Because of strong correlations, lanthanide- and actinide-bearing systems are not always well described by Density Functional Theory (DFT), which is the only computationally affordable method. We show results of DFT+U studies of different f-element-bearing oxides, phosphates, halogenides and zirconates that are of interest for nuclear waste management. We obtained the best description of these materials with the Hubbard U (and J) parameters derived for each cation and material using linear response method. Predicted structures of many of modelled materials agree surprisingly well with the measured ionic positions and lattice parameters. This is not seen when standard DFT methods are used. Our results indicate that simple modifications of DFT such as DFT+U, with properly estimated U parameter can successfully be used in computation of strongly correlated materials.

MP 13.4 Tue 8:00 SPA Foyer

Strong majorization entropic uncertainty relations — •Lukasz Rudnicki[1,2], Zbigniew Puchała[3,4], and Karol Zyczkowski[2,4] — [1]Freiburg Institute for Advanced Studies, Albert-Ludwigs University of Freiburg, Albertstrasse 19, 79104 Freiburg, Germany — [2]Center for Theoretical Physics, Polish Academy of Sciences, Aleja Lotników 32/46, PL-02-668 Warsaw, Poland — [3]Institute of Theoretical and Applied Informatics, Polish Academy of Sciences, Bałtycka 5, 44-100 Gliwice, Poland — [4]Institute of Physics, Jagiellonian University, ul Reymonta 4, 30-059 Kraków, Poland

We present new entropic uncertainty relations in a finite-dimensional Hilbert space. Using the majorization technique we derive several explicit lower bounds for the sum of two Rényi entropies of the same order. Obtained bounds are expressed in terms of the largest singular values of given unitary matrices. Numerical simulations with random unitary matrices show that our bound is almost always stronger than the well known result of Maassen and Uffink.

MP 13.5 Tue 8:00 SPA Foyer

Numerical solution to the Gross-Pitaevskii equation for dipolar Bose-Einstein condensates — Kishor Kumar R[1], Young-S. Luis E.[2], Dušan Vudragović[3], Antun Balaž[3], •Paulsamy Muruganandam[1], and Sadhan Kumar Adhikari[2] — [1]School of Physics, Bharathidasan University, Palkalaiperur Campus, Tiruchirappalli – 620024, Tamil Nadu, India — [2]Instituto de Física Teórica, UNESP – São Paulo State University, 01.140-70 São Paulo, São Paulo, Brazil — [3]Scientific Computing Laboratory, Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia

Many of the static and dynamic properties of dipolar Bose-Einstein condensates are can be studied from the Gross-Pitaevskii equation, a nonlinear nonlocal (integro-differential) partial differential equation. Here we develop a combined split-step Crank-Nicolson and fast Fourier transform based numerical scheme for both stationary and non-stationary solutions of the time-dependent Gross-Pitaevskii equation describing the properties of dipolar Bose-Einstein condensates at ultra low temperatures. We present results from the numerical scheme for energy, chemical potential, root-mean-square sizes and density of the dipolar BECs and compare them with results of other authors.

MP 13.6 Tue 8:00 SPA Foyer

Distribution of the Proper Delay Times of an Andreev Quantum Dot — •Jonas Lammers[1], Francesco Mezzadri[2], and Reinhard F. Werner[1] — [1]Institut für Theoretische Physik, Leibniz Universität Hannover — [2]School of Mathematics, University of Bristol, UK

Andreev Quantum Dots (QDs) are mesoscopic conductors in contact with superconductors which allow for phase-coherent transport of individual electrons and whose intrinsic classical dynamics is fully chaotic (disordered conductor). Instead of trying to predict the behavior of an individual dot it is sensible to treat QDs as stochastic entities, using Random Matrix Theory (RMT) to obtain the statistics of their properties. One of the transport properties of interest is the time delay suffered by incoming particles due to the complex dynamics inside. This is intimately related to the Wigner-Smith time delay matrix $Q = -i\hbar S^\dagger(\partial S/\partial E)$, which is determined by the energy-derivative of the system's unitary scattering matrix $S(E)$. More specifically we are interested in the distribution of the eigenvalues of Q, known as Proper Delay Times (PDTs). Their average gives the Wigner Time Delay, the average time a particle spends inside the QD, and they can be used to determine a number of other quantities beyond the time delay problem.

We compute the distribution $P(\tau_1,\ldots,\tau_N)$ of the PDTs of Andreev QDs for all four Altland-Zirnbauer random matrix symmetry classes, D, DIII, C, and CI, depending on the presence/absence of time-reversal invariance and/or spin-rotation symmetry.

MP 13.7 Tue 8:00 SPA Foyer

Multiple solutions of the time-independent Gross-Pitaeskii equation — •Želimir Marojević, Ertan Göklü, and Claus Lämmerzahl — ZARM - Center of Applied Space Technology and Microgravity, Bremen

We present a new algorithm which is capable to find saddle point solutions of the Gross-Pitaeskii action for large nonlinearites. It turns out that some of these solutions have unexpected complex structures. This algorithm has been applied to different situations in 2D and 3D, i.e. BEC in a harmonic trap, gravitational trap and no trap with Dirichlet boundary conditions.

MP 13.8 Tue 8:00 SPA Foyer

Correlated thermal machines in the micro-world — •Rodrigo Gallego — Dahlem Center for Complex Quantum Systems. 14195 Berlin-Dahlem

How much work can be extracted from a heat bath using a thermal machine? The study of this question has a very long tradition in statistical physics in the weak-coupling limit, applied to macroscopic systems. However, the assumption that thermal heat baths remain uncorrelated with physical systems at hand is less reasonable on the nano-scale and in the quantum setting, where correlations and entanglement may be expected to be prevalent. In this work, we establish a framework of work extraction in the presence of quantum correlations. We show in a mathematically rigorous and quantitative fashion that quantum correlations and entanglement emerge as a limitation to work extraction compared to what would be allowed by the second law of thermodynamics. At the heart of the approach are operations that capture naturally non-equilibrium dynamics encountered when putting physical systems into contact with each other. We discuss various limits that relate to known results and put our work into context of approaches to finite-time quantum thermodynamics.