DY 53: Poster Quantum Systems

Time: Thursday 15:00–18:00 Location: Poster B2

DY 53.1 Thu 15:00 Poster B2

Resonance–assisted tunneling in 4D normal–form Hamiltonians — •Markus Firmbach[1,2], Felix Fritzsch[1], Roland Ketzmerick[1,2], and Arnd Bäcker[1,2] — [1]TU Dresden, Institut für Theoretische Physik, Dresden — [2]MPI für Physik komplexer Systeme, Dresden

Dynamical tunneling is a paradigmatic example of the interplay of classical phase-space structures and the quantum effect of tunneling. In particular the presence of classical nonlinear resonances leads to significant enhancement of tunneling known as resonance–assisted tunneling. We describe this resonance–assisted tunneling in a 4D normal–form Hamiltonian as it captures all fundamental features. Focusing on the case of a double resonance we study the morphology of the quantum states. Quantitatively we describe tunneling in terms of the weight of these states in classically disconnected regions. By applying perturbative methods we reveal the underlying mechanism and obtain excellent qualitative and quantitative agreement with numerical data.

DY 53.2 Thu 15:00 Poster B2

Entanglement in bipartite systems with a mixed phase space — •Maximilian Kieler[1] and Arnd Bäcker[1,2] — [1]TU Dresden, Institut für Theoretische Physik, Dresden — [2]MPI für Physik komplexer Systeme, Dresden

The entanglement of pure states in a bipartite system can be characterized by the von Neumann entropy. We consider the case of two coupled quantized standard maps, where one map is chosen to be integrable while the other is fully chaotic. By increasing the coupling a transition to nearly maximal entanglement is found. We investigate the implications of the integrable part on the transition of the spectral statistics and the von Neumann entropy. The analytical description will be based on a suitable random matrix model and the identification of the relevant transition parameter.

DY 53.3 Thu 15:00 Poster B2

Geometry of complex instability in 4D symplectic maps — •Jonas Stöber[1] and Arnd Bäcker[1,2] — [1]TU Dresden, Institut für Theoretische Physik, Dresden — [2]MPI für Physik komplexer Systeme, Dresden

In dynamical systems with more than two degrees of freedom periodic orbits may show many different types of stabilities. For 4D symplectic maps so-called complex instability commonly occurs, which is not possible for 2D symplectic maps. For a specific 4D map we investigate the transition from elliptic to complex unstable dynamics of a fixed point under parameter variation. The change in the geometry of regular structures is visualized using 3D phase space slices and in frequency space. The chaotic dynamics is studied using escape time plots and by computations of the 2D invariant manifolds associated with the complex unstable fixed point.

DY 53.4 Thu 15:00 Poster B2

A microwave realization of the chiral GOE — •Aimaiti Rehemanjiang[1], Martin Richter[2,3], Ulrich Kuhl[2], and Hans-Jürgen Stöckmann[1] — [1]Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, D-35032 Marburg, Germany — [2]InPhyNi, Université Côte d'Azur, 06100 Nice, France — [3]School of Mathematical Sciences, University of Nottingham, Nottingham NG7 2RD, UK

The universal features of the spectra of chaotic systems are well reproduced by the corresponding quantities of the random matrix ensembles [1]. Depending on symmetry with respect to time reversal and the presence or absence of a spin 1/2 there are three ensembles: the Gaussian orthogonal (GOE), the Gaussian unitary (GUE), and the Gaussian symplectic ensemble (GSE). With a further particle-antiparticle symmetry there are in addition the chiral variants of these ensembles [2]. Relativistic quantum mechanics is not needed to realize the latter symmetry. A tight-binding system made up of two subsystems with only interactions between the subsystems but no internal interactions, such as a graphene lattice with only nearest neighbor interactions, will do it as well. First results of a microwave realization of the chiral GOE (the BDI in Cartan's notation) will be presented, where the tight-binding system has been constructed by a lattice made up of dielectric cylinders [3].

[1] O. Bohigas, M. J. Giannoni, and C. Schmit. PRL **52**, 1 (1984).
[2] C. W. J. Beenakker. Rev. Mod. Phys. **87**, 1037 (2015).
[3] S. Barkhofen, M. Bellec, U. Kuhl, and F. Mortessagne. PRB **87**, 035101 (2013).

DY 53.5 Thu 15:00 Poster B2

Stickiness in the volume-preserving Arnold-Beltrami-Childress map — •Swetamber Das[1] and Arnd Bäcker[1,2] — [1]Max-Planck-Institut für Physik komplexer Systeme, Dresden — [2]Technische Universität Dresden, Institut für Theoretische Physik, Dresden

Stickiness and power-law behavior of Poincaré recurrence statistics for higher-dimensional systems is still unexplained, while for systems for two degree-of-freedom, the mechanism is fairly well understood. We study such intermittent behavior of chaotic trajectories in three-dimensional volume-preserving systems using the example of the Arnold-Beltrami-Childress map. If two action-like variables of the map are nearly conserved, the phase space displays tubular regular structures surrounded by a chaotic sea. Stickiness occurs around these tubes and manifestations of partial barriers to transport are observed. We investigate this dynamics in phase space and in frequency space to identify the underlying origin of stickiness.

DY 53.6 Thu 15:00 Poster B2

Localization and transport in coupled kicked rotors — •Sanku Paul[1] and Arnd Bäcker[1,2] — [1]Max-Planck-Institut für Physik komplexer Systeme, Dresden 01187, Germany — [2]Technische Universität Dresden, Institut für Theoretische Physik, Dresden 01069, Germany

Coupled kicked rotors are a prototypical example of a periodically driven system. It consists of two one-dimensional rotors receiving periodic kicks as well as interacting with each other at the time of the kicks. We investigate the classical diffusion and quantum transport and its dependence on the strength of the coupling between the rotors.

DY 53.7 Thu 15:00 Poster B2

Relaxation dynamics after the removal of a static force: Binary operators and impact of eigenstate thermalization — •Jonas Richter[1], Jacek Herbrych[2], Jochen Gemmer[1], and Robin Steinigeweg[1] — [1]University of Osnabrück, Germany — [2]The University of Tennessee, USA

We study the relaxation dynamics of expectation values under unitary time evolution for a certain class of initial states. The latter are thermal states of the quantum system in the presence of an additional static force which, however, become nonequilibrium states when this force is eventually removed. While for weak forces the dynamics is well captured by linear response theory (LRT), the case of strong forces, i.e., initial states far away from equilibrium, is highly nontrivial. Employing a combination of analytical arguments as well as numerical calculations for interacting quantum lattice models, we unveil that the nonequilibrium dynamics at high temperatures can, in various cases, be universally generated by a single correlation function in the entire regime close to and far away from equilibrium. Specifically, we consider so-called binary operators and study, as an example, the dynamics of spinless fermions in a random potential. In addition, we discuss the role of the eigenstate thermalization hypothesis (ETH) and establish a connection between ETH and LRT.

[1] J. Richter, J. Herbrych, R. Steinigeweg, Phys. Rev. B **98**, 134302 (2018).
[2] J. Richter, R. Steinigeweg, arXiv:1711.00672.
[3] J. Richter, J. Gemmer, R. Steinigeweg, arXiv:1805.11625.

DY 53.8 Thu 15:00 Poster B2

Correlational latent heat by nonlocal quantum kinetic theory — •Klaus Morawetz — M\"unster University of Applied Sciences,Stegerwaldstrasse 39, 48565 Steinfurt, Germany — International Institute of Physics- UFRN,Campus Universit\'ario Lagoa nova,59078-970 Natal, Brazil

The nonlocal kinetic equation unifies the achievements of the transport in dense quantum gases with the Landau theory of quasiclassical transport in Fermi systems. Large cancellations in the off-shell motion appear which are hidden usually in non-Markovian behaviors [1]. The remaining corrections are expressed in terms of shifts in space and time that characterize the non-locality of the scattering process [2]. In this way quantum transport is possible to recast into a quasi-classical picture [3]. The balance equations for the density, momentum, energy and entropy include besides quasiparticle also the correlated two-particle contributions beyond the Landau theory [4]. The medium effects on binary collisions are shown to mediate the latent heat, i.e., an energy conversion between correlation and thermal energy. For Maxwellian particles a sign change of the latent heat is reported at a universal ratio of scattering length to the thermal De Broglie wavelength. This is interpreted as a change from correlational heating to cooling [5]. [1] Ann. Phys. 294 (2001) 135, [2] Phys. Rev. C 59 (1999) 3052, [3] "'Interacting Systems far from Equilibrium -Quantum Kinetic Theory"', Oxford University Press, (2017), ISBN 9780198797241, [4] Phys. Rev. E 96 (2017) 032106, [5] Phys. Rev. B 97 (2018) 195142

DY 53.9 Thu 15:00 Poster B2

Dynamics and equilibration of the finite spin-boson model — •Sebastian Wenderoth, Ulrich Wärring, Tobias Schätz, and Michael Thoss — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Freiburg, Germany

The study of thermalization processes in finite quantum systems has been of great interest recently. Of particular importance in this context is the eigenstate thermalization hypothesis, which states that the expectation values of few-body observables in an energy eigenstate are, under certain conditions, indistinguishable from microcanonical expectation values [1].
Recent experimental progress in the field of cold atoms and trapped ions, has made it possible to study these questions in tailored quantum systems. Inspired by a recent experimental realization of a finite version of the spin-boson model in a trapped ion experiment [2], we have theoretically investigated the dynamics of such a system.
Employing the Multiconfiguration time-dependent Hartree approach [3], which allows us to treat a large number of bosonic modes in a numerically exact way, we analyze the relaxation dynamics. In particular we investigate the dependence of the dynamics on the number of bosonic modes and the influence of a thermal initial state.

[1] M. Rigol *et al.*, Nature **452**, 854 (2008).
[2] G. Glos *et al.*, Phys. Rev. Lett. **117**, 170401 (2016).
[3] H. Wang *et al.*, New J. Phys. **10**, 115005 (2008).

DY 53.10 Thu 15:00 Poster B2

Equilibration and thermalization in the XXZ model — •Philipp Jaeger[1,2], Andreas Klümper[2], and Jesko Sirker[1] — [1]University of Manitoba, Department of Physics and Astronomy, Winnipeg, MB, Canada — [2]Bergische Universität Wuppertal, Fachbereich C - Fachgruppe Physik, Wuppertal, Germany

The quantum XXZ model is an integrable lattice model, hence exact solutions are available via Bethe ansatz (BA). For many ground-state properties or correlation functions, explicit expressions are available. Expectation values of observables at late times after a quench can be calculated for example using the generalized Gibbs ensemble (GGE) formalism. However, particular dynamical correlation functions (DCF) are notoriously hard to calculate from BA, and perturbations of the XXZ model can not be treated directly. Using numerics, it is possible both to obtain DCF relatively easy and to include perturbations. Here, we present numerical results obtained employing the light-cone renormalization group algorithm.

DY 53.11 Thu 15:00 Poster B2

Modelling cells as pressurized elastic shells — •Behzad Golshaei[1], Renata Garces[1], Samaneh Rezvani[1], Octavio E. Albarran[1], and Christoph F. Schmidt[1,2] — [1]Drittes Physikalisches Institut - Biophysik, Fakultät für Physik, Georg-August-Universität Göttingen, 37077 Göttingen — [2]Department of Physics, Duke University, Durham, NC 27708, USA

Animal cells and bacteria are enveloped and sealed by lipid membranes and mechanically protected by cortical polymer networks. Cells typically maintain a small (eukaryotic cells) or large (bacteria) positive osmotic pressure against their environment. Volume and shape regulation also impact the mechanical properties of cells. The mechanical properties of cells can be probed by exerting external force and measuring cell response. To better understand micromechanical optical trapping experiments with suspended rounded cells, and AFM experiments on bacteria, we employed finite element simulations and modelled cells as pressurized elastic shells.