# DY 37: Quantum Chaos II

Time: Thursday 16:00–17:15 Location: ZEU 118

DY 37.1 Thu 16:00 ZEU 118

**Efficiency of quantum ratchets** — •Fei Zhan, Sergey Denisov, Alexey V. Ponomarev, and Peter Hänggi — Insitute of Physics, University of Augsburg, Germany

Directed transport of matter-waves in optical periodic potentials can be initiated by modulation of the potential height, provided that the modulation protocol violates all relevant time and space symmetries. Quantum ratchets [1, 2] might be considered as a potentially new tool for the delivery of cold atoms to a desirable location. Unfortunately, the quantum transport is severely hampered by the diffusive spreading, which is enhanced by tunneling. The optimal regime is the one that maximizes net velocity and minimizes dispersion of the wave packet. We explore the impact of diffusion on the nonequlibrium quantum transport, focusing on the initially localized wave packets. By using a quantum version of the Péclet number, i.e. the ratio between the group velocity and the ballistic dispersion of a propagating matter-wave, we obtain the recipe for the optimization of quantum ratchet performance.

[1] S. Denisov, L. Morales-Molina, S. Flach, and P. Hänggi, Phys. Rev. A 75, 063424 (2007)
[2] T. Salger et al., Science 326, 1241 (2009)
[3] L. Machura et al., J. Phys. - Condensed Matter 17, S3741 (2005)

DY 37.2 Thu 16:15 ZEU 118

**Transport in Rough Quasi-One-Dimensional Systems** — •Otto Dietz[1], Ulrich Kuhl[1,2], Hans-Jürgen Stöckmann[1], Felix M Izrailev[3] und Nykolay M Makarov[3] — [1]Universität Marburg, Germany — [2]Université de Nice, France — [3]Universidad de Puebla, Mexico

Scattering at rough disordered boundaries strongly influence the conductance of nanowires. For rough silicon nanowires a much higher ratio of electric conductivity to thermal conductivity has been reported than expected from the Wiedemann-Franz law [1]. These findings have not been explained yet.

In the case of bulk disorder it is well known that correlations can drastically change conductance properties [2]. Similar effects have been predicted for rough nanowires [3] but drew little attention before their applicability to conductivity in silicon nanowires became evident.

We present a first experimental test of this theory in microwave waveguides with rough walls. Because of the strict analogy between the 2d Schrödinger equation and the Helmholtz equation, the results can be directly applied to electron transport in nano structures. Microwave techniques can be helpful because in contrast to real nanowires the surface roughness is both known and controllable. We could confirm that certain rough boundaries can block or enhance wave transport in given frequency windows.

[1] A. I. Hochbaum, et. al., Nature 451, 163 (2008).
[2] U. Kuhl, et.al., Appl. Phys. Lett. 77, 633 (2000).
[3] M. Rendón, et.al., Phys. Rev. B 75, 205404 (2007).

DY 37.3 Thu 16:30 ZEU 118

**GOE-GUE transition catastrophe in many body systems** — •Quirin Hummel, Juan Diego Urbina, Jack Kuipers, and Klaus Richter — Institute of Theoretical Physics, University of Regensburg, 93040 Regensburg, Germany

The quantum spectral fluctuations of classically chaotic systems undergo a transition between the orthogonal (GOE) and unitary (GUE) universality classes when a weak magnetic field is applied. In the context of Random Matrix Theory, closed analytical expressions for measures of spectral fluctuations (as the spectral form factor) are known for the full transition, and a semiclassical understanding of such results for single particle systems has emerged during the last years. We study how the semiclassical analysis is affected by going from single particle dynamics to a many body system of identical particles. We report here the apparent existence of a catastrophe in the GOE to GUE regime, in the sense that the mathematical limit where the number of particles tends to infinity produces a transition which is either infinitely slow or infinitely fast with respect to the magnitude of the applied magnetic field. We investigate to what extent interactions play a role in the corresponding analysis.

DY 37.4 Thu 16:45 ZEU 118

**Fractal Weyl law for three-dimensional chaotic hard-sphere scattering systems** — •Alexander Eberspächer[1], Jörg Main[2], and Günter Wunner[2] — [1]Institut für Theoretische Physik, Otto-von-Guericke Universität, 39016 Magdeburg, Germany — [2]Institut für Theoretische Physik 1, Universität Stuttgart, 70550 Stuttgart, Germany

The fractal Weyl law [1] connects the asymptotic level number with the fractal dimension of the chaotic repeller. We provide the first test for the fractal Weyl law for a three-dimensional open scattering system.

For the four-sphere billiard, we investigate the chaotic repeller and discuss the semiclassical quantization of the system by the method of cycle expansion with symmetry decomposition. We test the fractal Weyl law for various symmetry subspaces and sphere-to-sphere separations [2].

[1] W. T. Lu, S. Sridhar, and M. Zworski, Phys. Rev. Lett. 91, 154101 (2003).
[2] A. Eberspächer, J. Main, G. Wunner, Phys. Rev. E 82, 046201 (2010)

DY 37.5 Thu 17:00 ZEU 118

**From Fragile to Robust Pseudo-Hermitian Phase in Disordered $PT$-Symmetric Lattices** — •Ragnar Fleischmann — Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen

Non-hermitian Hamiltonians exhibiting $PT$-symmetry have sparked an extensive research effort in recent years due to their intriguing property of allowing for a pseudo-hermitian phase with an all real eigenvalue-spectrum [1]. This *$PT$-symmetric phase* in general will be spontaneously broken with the variation of a (gain/loss) parameter giving way to a *phase of broken$PT$-symmetry* with a fully or partially complex spectrum. Theoretical work on *$PT$-systems* spans from quantum field theory to solid state physics. Most recently, however, with the first experimental realizations of such systems using optical wave guides [2] the center of interest shifted onto photonic systems. Here I will present our recent results on the influence of disorder on symmetry breaking and dynamics in $PT$-symmetric tight binding models [3] that can be used to describe light propagation in optical wave guide arrays.

[1] C. M. Bender, Rep. Prog. Phys. 70, 947-1018 (2007).
[2] A. Guoet al., Phys. Rev. Lett. 103, (2009); C.E. Rüter et al, Nat Phys (2010).
[3] O. Bendix, R. Fleischmann, T. Kottos, and B. Shapiro, Phys. Rev. Lett. **103**(3):030402 (2009); O. Bendix, R. Fleischmann, T. Kottos, und B. Shapiro, J. Phys. A: Math. Theor. 43, 265305 (2010); M.C. Zheng, D.N. Christodoulides, R. Fleischmann, and T. Kottos (2010) Phys. Rev. A **82**(1):010103(R).