DY 37: Quantum Chaos

Time: Wednesday 15:30–17:00 Location: H6

DY 37.1 Wed 15:30 H6

Resonance eigenfunctions in systems with partial escape — •Konstantin Clauss[1], Eduardo Altmann[2], Arnd Bäcker[1,3], and Roland Ketzmerick[1,3] — [1]TU Dresden, Institut für Theoretische Physik, Dresden — [2]School of Mathematics and Statistics, University of Sydney — [3]MPI für Physik komplexer Systeme, Dresden

The phase-space distribution of chaotic resonance eigenfunctions corresponds to conditionally invariant measures of the classical system. This is well-understood if particles completely leave the system from a leaky phase-space region [1]. However, in many situations there occurs a partial escape of intensity, e.g., in optical microcavities. For such systems a similar understanding of resonance eigenfunctions is still missing and a completely new approach is required. For this we (i) find conditionally invariant measures for a given decay rate γ, and (ii) define a meaningful quantitative distance measure between phase-space densities to evaluate quantum-classical correspondence. We apply these methods to investigate the semiclassical limit and the limit of full escape.

[1] K. Clauß, M. J. Körber, A. Bäcker, and R. Ketzmerick, Phys. Rev. Lett. **121** (2018), 074101.

DY 37.2 Wed 15:45 H6

Towards universal Hong-Ou-Mandel correlations in topological insulators — •Andreas Bereczuk, Juan Diego Urbina, Cosimo Gorini, and Klaus Richter — Institut für Theoretische Physik, Universität Regensburg, Germany

The indistinguishable-distinguishable transition for the transmission probability for two fermions propagating through a quantum point contact is a known manifestation of the celebrated Hong-Ou-Mandel (HOM) effect [1] in electron quantum optics [2]. As shown in [3], universal HOM correlations are expected by substituting the quantum point contact by a chaotic cavity in a mesoscopic regime [3] where universal correlations of the scattering matrix entries at different energies predicted by Random Matrix Theory (RMT) [4] and semiclassical analysis enter. Here we present an analytical and numerical study of these correlations and propose a HOM setup with cavities as complex beam splitters and edge states instead of waveguides to observe universal HOM correlations in a topological insulators (TI). In this new setup where both TIs and normal metal scattering take place, the issue of the appropriate symmetry of the universality class requires further analysis.

[1] C. K. Hong, Z. Y. Ou and L. Mandel, Phys. Rev. Lett. 59, 2044 (1987)
[2] E. Bocquillon et al., Annalen der Physik 526, 1 (2014)
[3] J. D. Urbina et al., Phys. Rev. Lett. 116, 100401 (2016)
[4] M. Novaes, J. Math. Phys. 57, 122105 (2016)

DY 37.3 Wed 16:00 H6

Transport timescales in mixed phase space systems — •George Datseris[1,2], Lukas Hupe[1,2], Theo Geisel[1,2], and Ragnar Fleischmann[1,2] — [1]Max Planck Institute for Dynamics and Self-Organization — [2]Faculty of Physics, Georg-August-Universität Göttingen

In Hamiltonian systems with mixed phase space, nonlinear resonances form islands of regular motion in a chaotic sea of irregular motion. It is a well known that chaotic trajectories can get trapped near nonlinear resonances leading to long time tails in the correlation decay. We recently found, however, that due to the link between transit times and phase space volume ratios (as manifested by Kac's lemma), nonlinear resonances may influence correlation decays on fast time scales as well, simply by the phase space volume they occupy. This can explain puzzling experimental observations in magneto-transport in electronic nanodevices.

We extend on this finding studying billiards models with mixed phase space, like the mushroom billiard, and explore the relation between the resonance phase space fractions and the Lyapunov exponent.

DY 37.4 Wed 16:15 H6

Analytical Fresnel laws at convex and concave non-planar interfaces from a transfer matrix approach — •Sebastian Luhn and Martina Hentschel — Institute for Physics, Group for Theoretical Physics II / Computational Physics, Technische Universität Ilmenau Weimarer Str. 25, 98693 Ilmenau, Germany

Fresnel laws, the quantitative information of the amount of light reflected from a plane wave in dependence on its angle of incidence, are at the core of ray optics at planar interfaces. However, these formulae do not hold at curved interfaces and deviations are appreciable when wavelength and radius of curvature are of similar order. This is of particular importance for optical microcavities that play an important role in many modern research fields. Their convexely curved interfaces modify Fresnel's law in a characteristic manner. Most notably, the onset of total internal reflection is shifted to angles larger than critical incidence. Here, we fill the missing bit and derive exact Fresnel laws for concavely curved refractive index boundaries, enabling the exact description of light in complex mesoscopic optical structures that will be important in future nano- and microphotonic applications.

DY 37.5 Wed 16:30 H6

Resonance–Assisted Tunneling in Deformed Optical Microdisks with a Mixed Phase Space — •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

In optical microcavities dynamical tunneling leads to finite lifetimes of whispering gallery modes, which are classically confined by total internal reflection. The lifetimes of such modes may drastically decrease by resonance–assisted tunneling due to the presence of classical nonlinear resonances in the ray dynamics. We extend the description of resonance–assisted tunneling from near integrable systems to systems with a mixed phase space showing regular as well as chaotic dynamics. In particular, we present a qualitative semiclassical description based on ray dynamics. This provides an intuitive picture depending only on classical properties. For the case of a quadrupol cavity we combine these methods with a perturbative approach resulting in an accurate quantitative prediction of lifetimes and quality factors.

DY 37.6 Wed 16:45 H6

Motional narrowing in microwave graphs — •Tobias Hofmann[1], Aimaiti Rehemanjiang[1], Ulrich Kuhl[1,2], 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

Motional narrowing is a well-known phenomenon in nuclear magnetic resonance (NMR) spectroscopy and is caused by rapidly moving atoms in an inhomogeneous magnetic environment [1]. If there are just two sites involved, realized e. g. by a molecular flip between two geometries or configurational changes in a glassy network, an analytical solution is known [2]. Also in superconducting qubits with two stochastically fluctuating energies an analogue of the effect could be seen [3].

To simulate the effects of motional averaging and motional narrowing in microwave graphs stochastic switching has to be employed. This means to flip a resonance frequency of the graph between two values stochastically. The flip frequency is thereby comparable to or greater than the energy difference of the two resonance frequencies involved. By using a special diode circuit this frequency regime of typically some 10 MHz becomes accessible and the effects of motional averaging and motional narrowing can be observed in microwave graphs. The setup and experimental results will be presented.

[1] A. Abragam, Principles of Nuclear Magnetism, University Press Oxford 1961
[2] P. W. Anderson, J. Phys. Soc. Jpn. **9**, 316 (1954)
[3] J. Li et al., Nat. Comm. **4**, 1420 (2013)