# TT 48: Quantum Chaos (jointly with DY)

Time: Tuesday 14:30–16:00 Location: BH-N 334

TT 48.1 Tue 14:30 BH-N 334

**Regular phase-space structures and bifurcations in generic 4D symplectic maps** — •Franziska Onken[1], Steffen Lange[1], Arnd Bäcker[1,2], and Roland Ketzmerick[1,2] — [1]TU Dresden, Institut für Theoretische Physik, Dresden — [2]MPI für Physik komplexer Systeme, Dresden

The dynamics of Hamiltonian systems (e.g., planetary motion, electron dynamics in nano-structures, molecular dynamics) can be investigated by symplectic maps. While a lot of work has been done for 2D maps, much less is known for higher dimensions.

For a generic 4D map regular 2D-tori are organized around a skeleton of families of elliptic 1D-tori [1], which can be visualized by 3D phase-space slices [2]. We present an analysis of the different bifurcations of the families of 1D-tori in phase space and in frequency space by computing the involved hyperbolic and elliptic 1D-tori. Applying known results of normal form analysis, both the local and the global structure can be understood: Close to a bifurcation of a 1D-torus, the phase-space structures are surprisingly similar to bifurcations of periodic orbits in 2D maps. Far away the phase-space structures can be explained by remnants of broken resonant 2D-tori.

[1] S. Lange, M. Richter, F. Onken, A. Bäcker and R. Ketzmerick, *Global structure of regular tori in a generic 4D symplectic map*, Chaos **24**, 024409 (2014)

[2] M. Richter, S. Lange, A. Bäcker, and R. Ketzmerick, *Visualization and comparison of classical structures and quantum states of four-dimensional maps*, Phys. Rev. E **89**, 022902 (2014)

TT 48.2 Tue 14:45 BH-N 334

**How to deform a dielectric microcavity to get a given emission directionality** — •Marcus Kraft and Jan Wiersig — Otto-von-Guericke-Universität Magdeburg, 39016 Magdeburg

An important characteristic of dielectric microcavities is the far field emission pattern. Here, we present a method to find an optimized deformation of the boundary of a microcavity to get a predetermined far field pattern. We write the symmetric deformation of the boundary in a Fourier series and put this ansatz into a perturbation theory for weakly deformed microcavities. By minimizing the difference between the resulted and desired far field pattern we develop a system of linear equations for the Fourier coefficients of the deformed boundary. A comparison to full numerical calculations is also presented.

TT 48.3 Tue 15:00 BH-N 334

**Quantum Ergodicity in Open Chaotic Systems?** — •Konstantin Clauss[1], Martin Körber[1], Arnd Bäcker[1,2], and Roland Ketzmerick[1,2] — [1]TU Dresden, Institut für Theoretische Physik, Dresden — [2]MPI für Physik komplexer Systeme, Dresden

In open quantum systems a fundamental question concerns the phase-space localization of resonance states. For a fully chaotic phase space the resonance states are supported on a fractal set of classically trapped orbits. We investigate the possibility of quantum ergodicity, i.e. semiclassical equidistribution with respect to suitable classical densities on this fractal set. We explain why these classical densities have to be chosen according to the quantum decay rate.

TT 48.4 Tue 15:15 BH-N 334

**Frobenius-Perron operator for asymmetric backscattering in deformed microdisk cavities** — •Julius Kullig and Jan Wiersig — Institut für Theoretische Physik, Universität Magdeburg, Germany

Due to radiation and absorption optical microcavities cannot be described by hermitian but non-hermitian Hamiltonians of open quantum systems. This leads in general to non-orthogonal quasibound states. In case of asymmetric optical cavities this is related to an imbalance between clockwise (CW) and counter-clockwise (CCW) propagating waves which manifests in a finite chirality of quasibound states [1, 2, 3, 4]. This has applications e.g. in optical sensors [5], where so-called exceptional points in parameter space can be used to enhance sensitivity [6].

We study the backscattering process between CW and CCW waves from pure classical ray dynamics. To this end we construct a finite approximation of Frobenius-Perron operator $\mathcal{F}$ to describe the time evolution of phase-space densities. The eigenstates of $\mathcal{F}$ show interesting analogues to quasibound states, including non-orthogonality and chirality. Our method is demonstrated for a spiral geometry and the asymmetric Limaçon.

[1] J. Wiersig, S. W. Kim and M. Hentschel PRA 78, 053809 (2008); [2] J. Wiersig, A. Eberspächer, J.-B. Shim, J.-W. Ryu, S. Shinohara, M. Hentschel and H. Schomerus PRA 84, 023845 (2011); [3] J. Wiersig PRA 84, 063828 (2011); [4] J. Wiersig PRA 89, 012119 (2014); [5] F. Vollmer, L. Yang, Nanophotonics 1, 267 (2012); [6] J. Wiersig PRL 112, 203901 (2014)

TT 48.5 Tue 15:30 BH-N 334

**Ray-path reversal and Loschmidt echo for light beams** — •Pia Stockschläder and Martina Hentschel — Technische Universität Ilmenau, Institut für Physik, Ilmenau, Germany

A fundamental feature in classical geometrical optics is the reversibility of the light path. In reality, however, all light beams have finite width in contrast to the geometrical rays. This leads to corrections to ray optics – beam shift effects known as Goos-Hänchen shift and Fresnel filtering – which break ray-path reversibility. Here, we investigate in detail the influence of these corrections on the reversal of the optical path for a light beam reflected at a dielectric interface. As a measure of how much the reversed light path differs from the original one, we define and calculate a Loschmidt echo-like quantity in this context. As a possible technical application, we discuss the potential utilization of broken ray-path reversibility in optical sensors.

TT 48.6 Tue 15:45 BH-N 334

**Quantum-classical correspondence in electronic transport through quantum point contacts** — •Kazuhiro Kubo and Martina Hentschel — Technische Universität Ilmenau, Institut für Physik, Ilmenau, Germany

We investigate the propagation of electrons starting from a quantum point contact like source in a random potential. We present the density of classical trajectories which clearly shows the well-known branching pattern near the source and its gradual disappearance at larger distances. We calculate the semiclassical Green's function for each trajectory, and discuss how its amplitude is related to both the branching features and the conjugate points (caustics) along the trajectory. Furthermore, we complement these discussions by including quantum mechanical results.