DY 21: Quantum Chaos and Coherent Dynamics

Time: Tuesday 14:00–15:15 Location: MOL 213

DY 21.1 Tue 14:00 MOL 213

Bit-Flipping based on Stability Transition of Coupled Spins — •Maximilian F. I. Kieler and Arnd Bäcker — TU Dresden, Institut für Theoretische Physik, Dresden, Germany

A bipartite spin system is proposed for which a bit-flipping mechanism between two states is possible when the coupling is varied. The states correspond in the semiclassical limit to equilibrium points showing a stability transition from elliptic-elliptic stability to complex instability. Based on the classical system we find a universal scaling for the transfer time, which even applies in the deep quantum regime.

DY 21.2 Tue 14:15 MOL 213

New type of scarring in quantum chaotic scattering — •Jan Robert Schmidt and Roland Ketzmerick — TU Dresden, Institut für Theoretische Physik, Dresden, Germany

We study the three-disk scattering system, which is a paradigmatic example for quantum chaotic scattering. It is shown that any resonance state can be described by a product of a multifractal pattern of classical origin and universal, exponentially distributed fluctuations, as found for optical microcavities [1]. The first factor is determined by averaging resonance states with similar lifetime and is compared to an approximate conditionally-invariant measure from open chaotic maps [2]. A new type of scarring along ray segments, unrelated to periodic-orbit scarring, was recently observed in (partially open) optical microcavities [1]. Ray-segment scarring is just as well observed in the (fully open) three-disk system and has been overlooked for 30 years.

[1] R. Ketzmerick, K. Clauß, F. Fritzsch, and A. Bäcker, Phys. Rev. Lett. **129**, 193901 (2022).

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

DY 21.3 Tue 14:30 MOL 213

Manipulating light inside a microcavity with phase-space tailoring — Yan-Jun Qian[1], Hui Liu[1], Qi-Tao Cao[1], •Julius Kullig[2], Kexiu Rong[1], Cheng-Wei Qiu[3], Jan Wiersig[2], Qihuang Gong[1,4], Jianjun Chen[5], and Yun-Feng Xiao[1,4] — [1]Peking University, Beijing, China — [2]Otto-von-Guericke-University Magdeburg, Magdeburg, Germany — [3]National University of Singapore, Singapore, Singapor — [4]Shanxi University, Taiyuan, China — [5]Beijing Normal University, Beijing, China

We report on a novel powerful method for purposely manipulating light inside an optical microcavity. Via small absorptive, reflective or refractive elements embedded in the interior of the microcavity the photon transport is controlled in the phase space. Thus, phase-space tailoring allows for a spactial and tempral control of the light confinement enabling a manipulation of the far-field emissson pattern or the quality-factor.

DY 21.4 Tue 14:45 MOL 213

A spectral duality in graphs and microwave networks — •Tobias Hofmann[1], Junjie Lu[2], Ulrich Kuhl[1,2], and Hans-Jürgen Stöckmann[1] — [1]Fachbereich Physik, Philipps-Universität Marburg, 35032 Marburg, Germany — [2]Institut de Physique de Nice, CNRS, Université Côte d'Azur, 06108 Nice, France

Quantum graphs and their experimental counterparts, microwave networks, are ideally suited to study the spectral statistics of chaotic systems. The graph spectrum is obtained from the zeros of a secular determinant derived from energy and charge conservation. Depending on the boundary conditions at the vertices, there are Neumann and Dirichlet graphs. The first ones are realized in experiments, since the standard junctions connecting the bonds obey Neumann boundary conditions due to current conservation. On average, the corresponding Neumann and Dirichlet eigenvalues alternate as a function of the wave number, with the consequence that the Neumann spectrum is described by random matrix theory only locally, but adopts features of the interlacing Dirichlet spectrum for long-range correlations. Another spectral interlacing is found for the Green's function, which in contrast to the secular determinant is experimentally accessible. This is illustrated by microwave studies and numerics.

DY 21.5 Tue 15:00 MOL 213

Quantum Coherent Spin-Bath Dynamics and The Impact of Interactions on Quantum Memory Effects — •Tobias Boorman and Bernd Braunecker — University of St Andrews, St Andrews, United Kingdom

Using a robust theoretical framework, we systematically extract the joint-coherent dynamics of an impurity spin coupled to a strongly correlated material as the central process of a magnetic resonance. This framework enables a complete dynamical picture, extending beyond the usual high-temperature approximation that underpins the contemporary understanding of spin-bath decoherence, and allowing one to probe even further to the sub-thermal time regime, where quantum memory effects are the dominant feature. As a theoretically and experimentally accessible model of a strongly correlated conductor, we take the Luttinger liquid as a prototype to study how interactions alter the response of the bath to the impurity. Taken under the lens of the framework, we find that the joint quantum-coherent dynamics manifests itself as a rapid and seemingly instantaneous initial slip prior to the spin decoherence, whilst interactions within the bath play a role in modulating the amplitude and rate of this feature. We fit this understanding into a wider picture of magnetic resonance in interacting systems at intermediate temperatures, improving upon the known interaction-induced modifications of high-temperature approximations.