

DY 61: Posters - Quantum Systems

Time: Thursday 17:00–19:30

Location: P1A

DY 61.1 Thu 17:00 P1A

Perturbation theory for asymmetric deformed optical microdisk cavities — ●JULIUS KULLIG and JAN WIERSIG — Institut für Theoretische Physik, Otto-von-Guericke-Universität Magdeburg, Postfach 4120, D-39016 Magdeburg, Germany

Optical microdisk cavities confine light into very small volumes for long times. Via slight boundary deformations the cavity can be designated for a desired application; e.g. for unidirectional light emission or as sensor device. However, in real experiments slight deformations destroy mirror-reflection symmetry either intended or unintended via production tolerances. Therefore we have generalized the perturbation theory for microdisk cavities to treat such asymmetric deformations. This allows us to describe interesting non-Hermitian phenomena like copropagation of optical modes in the (counter-)clockwise direction inside the cavity. The derived analytic formulas are demonstrated at two generic boundary shapes, the spiral and the double-notched circle where a good agreement to the numerical boundary element method is observed.

DY 61.2 Thu 17:00 P1A

Phase-space localization in absorbing quantum maps — ●KONSTANTIN CLAUSS¹, MARTIN KÖRBER¹, TOBIAS BECKER¹, ARND BÄCKER^{1,2}, and ROLAND KETZMERICK^{1,2} — ¹TU Dresden, Institut für Theoretische Physik, Dresden — ²MPI für Physik komplexer Systeme, Dresden

In absorbing quantum systems a fundamental question concerns the phase-space localization of resonance states. The semi-classical description of a chaotic resonance state is given by a classical conditionally invariant measure with the same decay rate. We present a construction of such measures that generalizes the classical natural decay to arbitrary decay rates. We investigate (i) quantum mechanical deviations, (ii) the case of partial absorption, and (iii) the applicability to a mixed phase space.

DY 61.3 Thu 17:00 P1A

Separatrix modes in weakly deformed microdisk cavities — ●CHANG-HWAN YI^{1,2}, JULIUS KULLIG², JI-WON LEE¹, JI-HWAN KIM¹, HYEON-HYE YU³, JAN WIERSIG², and CHIL-MIN KIM¹ — ¹Department of Emerging Materials Science, DGIST, Daegu 711-873, Korea — ²Institut für Theoretische Physik, Otto-von-Guericke-Universität Magdeburg, Postfach 4120, D-39016 Magdeburg, Germany — ³Department of Physics, Sogang University, Seoul 121-742, Korea

Quasi stationary modes in deformed dielectric microdisk cavities show an unexpected localization along unstable periodic ray orbits. We reveal a mechanism for this kind of localization in weakly deformed cavities. In such systems the ray dynamics is nearly integrable and its phase space contains small island chains. When increasing the deformation the enlarging islands incorporate more and more modes. Each time a mode comes close to the border of an island chain (separatrix) the mode exhibits a strong localization near the corresponding unstable periodic orbit. Using an Einstein-Brillouin-Keller quantization scheme taking into account the Fresnel coefficients we derive a frequency condition for the localization. Observing far field intensity patterns and tunneling distances, reveals small differences in the emission properties.

DY 61.4 Thu 17:00 P1A

Resonance-assisted tunneling in 4D normal-form systems — ●MARKUS FIRMBACH¹, FELIX FRITZSCH¹, ARND BÄCKER^{1,2}, and ROLAND KETZMERICK^{1,2} — ¹TU Dresden, Institut für Theoretische Physik, Dresden — ²MPI für Physik komplexer Systeme, Dresden

Nonlinear resonances are ubiquitous in higher-dimensional systems, however, a quantitative description of their influence on quantum dynamical tunneling is still lacking. To understand resonance-assisted tunneling in higher-dimensional system we use a 4D resonant normal-form system. Focusing on the case of a double resonance, we obtain tunneling rates showing resonance-assisted enhancement as well as suppression. Using quantum perturbation theory we reveal the underlying mechanism for these phenomena.

DY 61.5 Thu 17:00 P1A

Phase space and frequency space of the spatial circu-

lar restricted three-body problem — ●MARTIN LANGER¹ and ARND BÄCKER^{1,2} — ¹TU Dresden, Institut für Theoretische Physik, Dresden, Germany — ²MPI für Physik komplexer Systeme, Dresden, Germany

The spatial circular restricted three-body problem is a Hamiltonian system with three degrees of freedom, describing for example the dynamics of an asteroide in the field of two heavy masses moving on circular orbits. By a Poincaré section this can be reduced to a 4D symplectic map. To visualize the dynamics in phase space, in particular around the Lagrangian triangular equilibria $\mathcal{L}_{4,5}$, we use the recently introduced 3D phase space slices and chaos indicators. We relate regular phase-space structures with those in frequency space and explain the organization of phase space using lower-dimensional tori.

DY 61.6 Thu 17:00 P1A

Driven, dissipative dynamics of a Dicke model: relaxation and pumping — ●CHRISTOS BOKAS, BJÖRN KUBALA, and JOACHIM ANKERHOLD — Institute for Complex Quantum Systems and IQST, Ulm University, Ulm, Germany

A dissipative Dicke model can be realized in a new hybrid architecture, where a cloud of cold atoms is brought close to a superconducting microwave resonator. We establish a description of this hybrid in the quasi-continuum limit of a large number of atoms by deriving a mapping on single-particle motion in a single effective two-dimensional potential, so that the full coherent dynamics far from equilibrium can be investigated. Dissipative dynamics is then incorporated by the quantum jump method.

Within this framework, numerical simulations are feasible even for thousands of atoms in various non-equilibrium scenarios of interest. Exemplary, we study, how the system starting from a highly excited atomic cloud relaxes to equilibrium through a “superradiant burst”. Via a time-dependent coupling between atoms and cavity, the system is pumped through the phase transition between normal and superradiant state.

DY 61.7 Thu 17:00 P1A

Amended ray-optical description of dielectric optical microcavities — ●PIA STOCKSCHLÄDER and MARTINA HENTSCHEL — Institut für Physik, Technische Universität Ilmenau, Weimarer Straße 25, 98693 Ilmenau, Germany

Dielectric optical microcavities and microlasers have attracted much attention because of their possible applications in photonics or optoelectronics. It has proven useful to describe these systems based on geometrical optics. In this efficient and easily implemented approach, the dielectric cavities can be considered as open billiards. Using the concept of ray-wave correspondence, much insight can be gained about the mode structure and the emission characteristics. Here, we discuss some aspects of an amended ray description of dielectric optical microcavities focusing on the determination of the far-field emission pattern. Firstly, we examine the differences between the modelling of cavities with predominantly chaotic and with non-chaotic classical billiard dynamics (chaotic and non-chaotic cavities, for short). For chaotic cavities, it is well known that the far-field is determined by the overlap of the unstable manifold of the chaotic saddle with the leaky region. For non-chaotic cavities, on the other hand, the trajectories with the smallest, nonzero decay rates dominate the emission pattern. Secondly, we include wave-inspired corrections to the ray-optics which can be important for the reliable description of small cavities. We discuss the influence of these correction terms for systems with curved and with planar boundaries, as well as for systems with chaotic and non-chaotic dynamics.

DY 61.8 Thu 17:00 P1A

Semi-Classics in many-body spin chains — MARAM AKILA, ●DANIEL WALTNER, BORIS GUTKIN, PETR BRAUN, and THOMAS GUHR — Fakultät für Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg

Recently, we discovered an exact trace duality for kicked, one dimensional spin chains. It expresses traces of the unitary evolution operator for N spins and T time-steps by traces of an operator whose dimension is determined by T instead of N . This simplification allows us to address large spin systems at practically arbitrary N . With this at

hand, we can perform a semi-classical analysis of a many-body system, determining (action-)spectra and their correspondence to classical periodic orbits. In this initial study we illustrate challenges of mixed classical dynamics, the exponential orbit count proliferation with N ,

and possible pathways to overcome these obstacles.