DY 27: Quantum chaos III

Time: Thursday 11:15–12:45 Location: H2

DY 27.1 Thu 11:15 H2

Beitrag abgesagt — •XXX XXX —

DY 27.2 Thu 11:30 H2

Semiclassical studies of the influence of spin-orbit interaction on transport through ballistic chaotic quantum dots — Jens Bolte[1] and •Daniel Waltner[2] — [1]Institut für Theoretische Physik, Universität Ulm, Albert-Einstein-Allee 11, 89081 Ulm, Germany — [2]Institut für Theoretische Physik, Universität Regensburg, Universitätsstraße 31, 93040 Regensburg, Germany

The semiclassical justification of the results obtained by Random Matrix Theory for spectral statistics and transport is an important issue of current research in quantum chaos.

By using the Landauer approach and semiclassical methods, we investigate the influence of weak spin-orbit interaction on transport through classically chaotic billiards. By assuming the ergodicity of the combined phase-space dynamics, we are able to reproduce the complete result for the conductivity of the system from the circular symplectic ensemble of Random Matrix Theory and to explain weak localization and weak antilocalization.

DY 27.3 Thu 11:45 H2

Semiclassical theory of weak localization in regular billiards: the role of diffractive effects — •Iva Brezinova[1], Christoph Stampfer[2], Joachim Burgdörfer[1], Ludger Wirtz[3], and Stefan Rotter[1] — [1]Institute for Theoretical Physics, Vienna University of Technology, Wiedner Hauptstraße 8-10&136, A-1040 Vienna, Austria, EU — [2]Chair of Micro and Nanosystems, Swiss Federal*Institute of Technology Zurich (ETH Zurich), Tannenstr. 3, 8092 Zurich, Switzerland — [3]Institute for Electronics, Microelectronics and Nanotechnology, B.P. 60069, 59692 Villeneuve d*Ascq Cedex, France, EU

Weak localization is a quantum interference effect observed in quantum billiards: the conductance through the system is suppressed compared to the classical prediction. Application of a perpendicular magnetic field increases the conductance giving rise to a characteristic dip.

We present a semiclassical theory of weak localization applicable to both regular as well as chaotic quantum billiards. The theory includes pseudo-paths consisting of classical paths joined by diffractive scatterings at the entrance and exit of the billiard. These pseudo-paths connect the classically disjoint path sets of reflected and transmitted paths and thus improve the unitarity of the semiclassical theory. For regular systems we have succeeded in adding up all classical paths as well as the pseudo-paths up to a given length. We compare the semiclassical resistance and conductance with quantum results and find good agreement. We show for a regular system (circular billiard) that the characteristic dip of the conductance as a function of the magnetic field disappears if all non-classical paths are removed.

DY 27.4 Thu 12:00 H2

Breakdown of retracing in Andreev eigenstates — •Florian Libisch, Stefan Rotter, and Joachim Burgdörfer — Vienna University of Technology, Wiedner Hauptstraße 8-10, Vienna, Austria, EU

Modern manufacturing techniques of semiconductor devices allow the study of single electrons confined to two-dimensional cavities, with linear dimension of the order of a micrometer and below. Such devices are typically referred to as "quantum billiards". Replacing part of the hard wall of the billiard by a superconductor (S) gives rise to coherent scattering of an incoming electron into an outgoing hole. This process, generally known as Andreev reflection, connects the electron and hole degrees of freedom. Classically, the hole emitted by the S-boundary follows the time-reversed path of the electron. At its next contact with the superconductor the hole is converted back into an electron, thereby forming a periodic electron-hole orbit. As a consequence, a semiclassical model based on Andreev retroreflection predicts the electron- and hole eigenstates to mirror each other.

We explicitly calculate the quantum mechanical eigenstates of Andreev billiards, whose classical counterparts feature regular as well as chaotic dynamics. By comparing the wave functions for holes and electrons, the degree of quantum-classical correspondence of the dynamics can be probed. We find eigenstates whose electron and hole components feature qualitatively different patterns, marking the influence of purely quantum mechanical effects.

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DY 27.5 Thu 12:15 H2

Classical phase space revealed by coherent light — •Martina Hentschel[1] and Takahisa Harayama[2] — [1]MPIPKS Dresden, Nöthnitzer Str. 38, 01187 Dresden — [2]ATR Wave Engineering Laboratories, 2-2-2 Hikaridai, Kyoto 619-0228, Japan

We study the far field characteristics of oval-resonator laser diodes made of an AlGaAs/GaAs quantum well. The resonator shapes are various oval geometries, thereby probing chaotic, mixed, and integrable classical dynamics. The far field pattern of the lasing cavities shows a pronounced fine structure that strongly depends on the cavity shape. We compare the experimental data with ray-model simulations for a Fresnel billiard and find convincing agreement for all geometries. This allows us to trace back the origin of the far field characteristics fine structure and reveals the importance of the underlying classical phase space for the lasing characteristics.

DY 27.6 Thu 12:30 H2

Temporal flooding of regular islands by chaotic wave packets — Arnd Bäcker, •Lars Bittrich, and Roland Ketzmerick — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

We investigate the time evolution of wave packets in systems with a mixed phase space where regular islands and chaotic motion coexist. If a wave packet is started in the chaotic sea, the weight on a quantized torus of the regular island increases with time until a saturation plateau is reached. This saturation value varies from torus to torus with a maximum value corresponding to a uniform distribution of the wave packet. The initial behaviour of this flooding process is quantitatively described by dynamical tunneling rates. The saturation value is obtained from a suitable random matrix model. The results are in good agreement with numerical data.