DY 30: Quantum Chaos II

Time: Thursday 15:00–16:15 Location: H47

DY 30.1 Thu 15:00 H47

Edge-independent formation of localized states in manipulated honeycomb lattices — •Pia Adam and Martina Hentschel — Institut für Physik, Technische Universität Ilmenau, Germany

We investigate finite hexagonal lattice systems with different boundary conditions under the influence of strain and local deformations. To this end, we use a tight-binding model including up to third nearest neighbor coupling. This model allows us to describe real graphene as well as honeycomb photonic crystals. First, we study the effect of unidirectional strain by varying the nearest neighbor coupling in one direction. In a microwave realisation of this problem with armchair boundary conditions a phase transition under increasing strain from a gapless to a gapped phase is predicted and observed. Moreover, localized states form at the edges perpendicular to the strain on a hexagon with armchair edges [1]. We confirm these results and, in particular, find them to hold for zigzag edges as well, i.e. to be independent of the edge termination. Furthermore, we investigate the effect of local deformations simulated by locally changing the nearest neighbor interaction. This leads to states which are strongly localized at the sites adjacent to the deformed bonds with energies at the low and high energy flanks of the spectrum rather than near the Dirac point.

[1] M. Bellec, U. Kuhl, G. Montambaux, F. Mortessagne, arXiv:1210.4642 [cond-mat.mes-hall].

DY 30.2 Thu 15:15 H47

Experimental observation of resonance assisted tunneling in systems with a mixed phase space — •Stefan Gehler[1], Steffen Löck[2,3], Ulrich Kuhl[1,4], Hans-Jürgen Stöckmann[1], Susumu Shinohara[5], Arnd Bäcker[2,5], and Roland Ketzmerick[2,5] — [1]Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, 35032 Marburg, Germany — [2]Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany — [3]OncoRay, Technische Universität Dresden, Fetscherstr. 74, 01307 Dresden, Germany — [4]LPMC, CNRS UMR 7336, Université de Nice Sophia-Antipolis, 06108 Nice, France — [5]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, 01187 Dresden, Germany

In quantum mechanical billiards with a mixed phase space tunnelling from regular islands to the chaotic sea can be strongly increased by resonance-assisted tunnelling [1,2]. This occurs due to nonlinear resonances, which cause different regular states to be close in energy. To experimentally verify this theory we designed a cosine-shaped microwave resonator with suitably placed absorbers destroying the resonances of the chaotic sea but not affecting the stable island. Then the tunnelling rate can be determined via the width of the resonances. Our experimental results are in agreement with theoretical predictions.

[1] O. Brodier, P. Schlagheck, D. Ullmo, Phys. Rev. Lett. 87, 064101 (2001).

[2] S. Löck et al., Phys. Rev. Lett. 104, 114101 (2010).

DY 30.3 Thu 15:30 H47

Quantum Goos-Haenchen effect on wave-packet dynamics — •Soo-Young Lee — Max Planck Institute for the Physics of Complex Systems, Dresden

When an optical beam is totally reflected from a dielectric interface, there exists some lateral shift of the reflected beam from the incident point of the beam, this is called Goos-Haenchen (G-H) shift. This comes from the angle-dependent phase loss appearing upon the total internal reflection.The G-H effect can be also found in quantum mechanical problems. We study the quantum G-H effect in step-potential problem and normal/superconductor (NS) interface. In particular, we focus on how the G-H effect changes wave-packet dynamics in the various interfaces. It turns out that the G-H effect in the NS interface is amplified by the ratio between Fermi energy and the pair gap, and it gives only time delay without any lateral shift.

DY 30.4 Thu 15:45 H47

Are Fresnel filtering and the angular Goos-Hänchen shift the same? — •Jörg Götte[1], Susumu Shinohara[2], and Martina Hentschel[3] — [1]Max-Planck-Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, D-01187 Dresden, Germany — [2]NTT Communication Science Laboratories, NTT Corporation, 2-4 Hikaridai, Seika-cho, Soraku-gun, Kyoto 619-0237, Japan — [3]Technische Universität Ilmenau, Institut für Physik, Weimarer Str. 25, D-98693 Ilmenau, Germany

In dielectric billiards ray dynamics have to be amended to account for wave effects, such as the spatial Goos-Hänchen shift. This shift is a small displacement upon transmission or reflection of a light beam of finite width. The idea is to change the reflection coefficients for rays to include wave phenomena in an effective way.

These wave phenomena not only alter the dynamics in the spatial domain, but also in the angular domain. Two effects are known in the literature, Fresnel filtering and the angular Goos-Hänchen shift, which both cause a deflection of the light beam with respect to Snell's law or the law of reflection.. This raises the question which of these two effects is more important for an improved ray-wave correspondence.

We approach this question by highlighting the similarities and differences between the two effects and study the dynamical currents of the optical field upon reflection and transmission.

DY 30.5 Thu 16:00 H47

On the fractal dimension spectrum of open chaotic systems — •Moritz Schönwetter[1], Orestis Georgiou[2], and Eduardo Altmann[1] — [1]MPIPKS, Dresden — [2]Toshiba Research Europe Limited, Bristol, England

Wave and quantum properties of open systems are nowadays understood in terms of the invariant sets of their classically chaotic counterparts as for example in the fractal Weyl law connecting the asymptotic resonance density with the fractal dimension of the classical repeller. In this talk we introduce an efficient and accurate algorithm to numerically compute the full spectrum of Renyi-dimensions (D_q), and use it to investigate physically relevant classes of Hamiltonian systems exhibiting interesting D_q: (i) systems with a non-hyperbolic component, in which case we argue that the dimensions should be considered scale-dependent and the dynamics characterized by effective dimensions; and (ii) open systems in which trajectories are only partially reflected in a region of the boundary and which exhibit a non-constant D_q spectrum (multifractals).