SESSION YC28: QUANTUM CHAOS
Friday morning, 26 March 1999
Room 168W GWCC at 11:00
Richard Prange, University of Maryland, presiding

11:00

YC28 1 Square Billiards with Magnetic Flux R. NAREVICH, R.E. PRANGE, OLEG ZAITSEV *Department of Physics, University of Maryland, College Park MD 20742* The square quantum billiard in a uniform weak magnetic field, or the billiard with one or more Aharonov-Bohm flux lines, has attracted recent attention[1]. 'Weak' field is defined by the condition: cyclotron radius $>>$side of billiard. There is little *classical* consequence of such weak fields and certainly there is no classical effect for the Aharonov-Bohm flux lines, but the *quantum* phase interference effects associated with the vector potential lead to shifts of the energy levels and a change of level statistics from GOE to GUE. We have found analytically and confirmed numerically, remarkable new and unexpected *localization* effects on *wavefunctions* due to phase interference. Anderson localization is such an effect which occurs in random systems. By contrast, this effect is in a nearly integrable system and the results are expressible by simple approximate analytic wavefunctions and energy levels. The results are obtained by application of a more general technique we recently developed[2]. Supported in part by U.S.-Israel BSF 95-00067-2. Supported in part by NSF DMR 9624559.

[1]K. Richter et al. Phys. Rep. **276**, 1 (1996); G. Date et al. Phys. Rev. **E51**, 198 (1996); M. A. M. de Aguiar, Phys. Rev. **E53**, 4555 (1996)

[2]R. E. Prange et al. chao-dyn 9802019, (1998); R. E. Prange et al. chao-dyn 9807021, (1998)

11:12

YC28 2 Classical and quantum chaos in ray-splitting billiards A. KOHLER, *Freiburg University* R. BLUMEL, *Wesleyan University* A ray-splitting billiard contains potential steps or potential singularities in its interior. Ray splitting governed by a new non-deterministic non-Newtonian classical mechanics occurs at the potential steps or singularities. We studied the classical and quantum implications of ray splitting for integrable and chaotic ray-splitting billiards. We computed analytically and tested numerically general experessions for the ray-splitting corrections to the Weyl-formulas for the average level density of ray-splitting billiards in two and three dimensions. Fourier transforming scaled quantum spectra of ray-splitting billiards we found the signatures of non-Newtonian periodic orbits. We also found the signatures of periodic lateral-ray orbits. Microwave realizations of ray-splitting billiards are discussed.

11:24

YC28 3 Interactions and integrability in a quantum billiard.* LILIA MEZA-MONTES, *Instituto de Física-UAP, Apdo. Postal J-48, Puebla, Pue. México 72570* SERGIO E. ULLOA, *Department of Physics & Astronomy-CMSS, Ohio University, Athens, OH 45701* We have studied the quantum problem of two interacting particles inside a circular billiard, which it is known to be integrable for the one-particle case. The basis for the interacting problem consists of a set of functions generated by a method of Finite Elements and a full diagonalization procedure has been performed to obtain the spectrum. In this work, we will discuss the role of Coulomb interactions on the integrability of the system by means of level statistics analysis.Although the geometry gives a Poisson distribution of nearest-neighbor spacings, we find substantial differences for the interacting case.

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11:36

YC28 4 Spectral properties of magnetized pacman and sector quantum dot billiards A. GÓNGORA-T, *Centro de Ciencias Físicas, Universidad Nacional Autónoma de México, Cuernavaca, Morelos, México* J. V. JOSÉ, *Physics Department, Northeastern University, Boston Mass, USA* P. H. E. TIESINGA, *Salk Institute, La Jolla, California, USA** We have studied in detail the spectral eigenvalue and eigenvector properties of an electron confined to either a sector or a pacman-shaped quantum dot billiard, in the presence of a constant homogeneous magnetic field. We compare our results to those of a circular disk in a homogeneous magnetic field, in which energy and angular momentum are conserved. We find explicit spectral relations between the eigenvalues of the sector and the pacman and study their relevance for the confined magnetic circular and skipping orbits in both cases. We also calculate the magnetization and orbital electronic currents. We intend to make a connection with quantum dot experiments in magnetic fields.

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11:48

YC28 5 Quantum chaos in billiards within Bohm's quantum mechanics J. FLORENCIO, *Universidade Federal de Minas Gerais* O. F. DE ALCANTARA BONFIM, *Reed College* F. C. SA' BARRETO, *Universidade Federal de Minas Gerais* We have investigated the dynamics of a quantum particle in square and circular billiards by using Bohm's quantum mechanics. We find that for both geometries the motion of the particle can be either regular or chaotic, depending on the initial form of the wave packet and on the particle's initial position. The nature of the Bohmian trajectories is not determined by the level spacing distribution. In both cases, the level spacing follows a Poisson-like distribution, which would suggest regular behavior, yet we find instances where the motion is clearly chaotic. Moreover, the chaotic nature of the Bohmian trajectories is not dictated by whether or not the underlying classical Hamiltonian counterpart is chaotic.

12:00

YC28 6 Can a Bohmian trajectory be chaotic for a particle in a one-dimensional potential? O. F. DE ALCANTARA BONFIM, *Reed College* J. FLORENCIO, *Universidade Federal de Minas Gerais* F. C. SA' BARRETO, *Universidade Federal de Minas Gerais* The dynamics of a quantum particle in one-dimensional potentials is studied within the framework of Bohm's quantum mechanics. We consider both continuos and discontinuos potentials. Contrary to arguments found in the literature which claim that chaotic Bohmian trajectories are not possible in one-dimensional systems, we do find such trajectories in our study. We also find that an appropriate choice for the initial position and wave packet causes the particle to undergo periodic, quasiperiodic, or chaotic motion. The transitions between these regimes occur in a continuos fashion.