Authors:

B. Dietz, T. Klaus, M. Miski-Oglu, A. Richter, M. Wunderle

Title:

Microwave Billiards, Graphene and Fullerene C60

Abstract:

We determined experimentally the eigenvalues of quantum billiards with the shapes of a rectangle and of Africa, respectively, that contained circular scatterers forming a triangular grid, so-called Dirac billiards. For this, high-precision measurements have been performed with superconducting microwave billiards.

In the first part of my talk I will shortly review the salient properties of classical, quantum and microwave billiards.

In the second part of my talk, I will present results concerning the particular features of the density of states (DOS) of Dirac billiards, which resembles that of a graphene flake, and their spectral fluctuation properties. I will demonstrate that the van Hove singularities, that show up as sharp peaks in the DOS, divide the band structure into regions where the system is governed by the non-relativistic Schrödinger equation of the quantum billiard and the Dirac equation of the graphene billiard of corresponding shape, respectively.

In the third part of my talk I will present experiments that have been performed using a spherical superconducting microwave resonator with the geometric structure of the C60 fullerene molecule. Firstly, we studied the exceptional spectral properties emerging from the symmetries of the icosahedral structure of the carbon lattice. Secondly, we determined the number of zero modes with eigenvalues at the Dirac point to test the predictions of the Atiyah-Singer index theorem, which relates it to the topology of the curved carbon lattice. For this purpose, we performed numerical calculations in order to extend the experimental results to larger fullerene molecules.

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