

# Quantum chaos of generic systems

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Quantum chaos (or wave chaos) is a research field in theoretical and experimental physics dealing with the phenomena in the quantum domain (especially regarding solutions of the Schroedinger equation), or in other wave systems, which correspond to the classical chaos. These other wave systems are electromagnetic, acoustic, elastic, surface, seismic, gravitational waves, etc. The classical dynamics describes the "rays" of the underlying waves, and the bridge between the classical and quantum mechanics is the semiclassical mechanics, resting upon the short-wavelength approximations. If the classical dynamics is chaotic, we see clear signatures in the quantum (wave) domain, e.g. in statistical properties of discrete energy spectra, in the structure of eigenfunctions, and in the statistical properties of other observables. Quantum chaos occurs in low-dimensional systems, e.g. with just two degrees of freedom (e.g. in 2D billiards), but of course also in multi-dimensional systems. From the above it is obvious that theory and experiment in quantum chaos are of fundamental importance in physics, and, moreover, also in technology.

In generic Hamilton systems we have regions of stable, regular, motion in the classical phase space for certain initial conditions, and chaotic motion for the complementary initial conditions. Accordingly, the corresponding eigenstates are either regular or chaotic, and also the corresponding energy spectra have different statistical properties, namely either Poissonian for the regular eigenstates or the statistics of random matrices in the chaotic case. In order to decide whether a given eigenstate and the corresponding energy level is regular or chaotic, we must look into the structure of Wigner functions in the "quantum phase space".

## References

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