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The Spatiotemporal Evolution of Wave Packets under Chaotic Condition

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Abstract: Using the minimum uncertainty state of quantum integrable system H_0 as initial state, the spatiotemporal evolution of the wave packet under the action of perturbed Hamiltonian is studied causally as in classical mechanics. Due to the existence of the avoided energy level crossing in the spectrum there exist nonlinear resonances between some pairs of neighboring components of the wave packet, the deterministic dynamical evolution becomes very complicated and appears to be chaotic. It is proposed to use expectation values for the whole set of basic dynamical variables and the corresponding spreading widths to describe the topological features concisely such that the quantum chaotic motion can be studied in contrast with the quantum regular motion and well characterized with the asymptotic behaviors. It has been demonstrated with numerical results that such a wave packet has indeed quantum behaviors of ergodicity as in corresponding classical case.

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