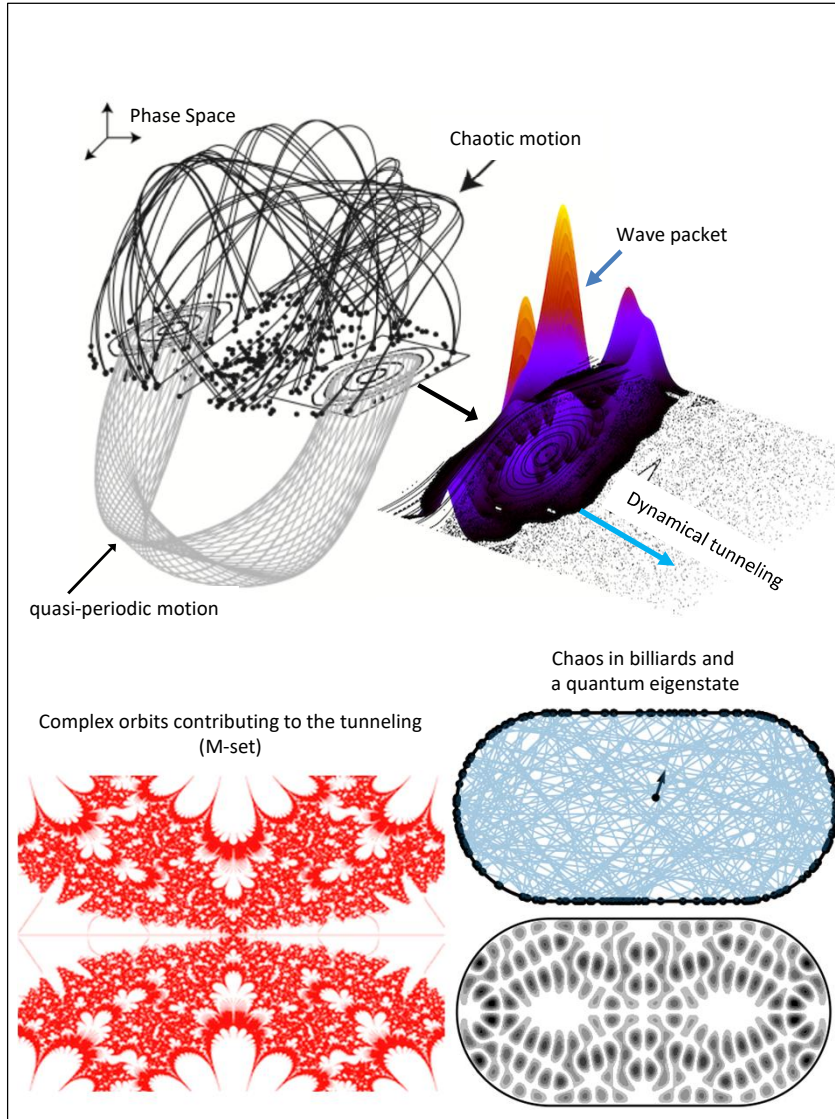




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Hamiltonian dynamical systems and quantum chaos

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Hamiltonian dynamical systems that preserve symplectic structure are generally non-integrable for systems with two or more degrees of freedom. Chaos and quasi-periodic motion on KAM tori coexist on the energy surface. KAM tori act as dynamical barriers that prevent the system from becoming ergodic. Conversely, quantum wave packets can penetrate these dynamical barriers via quantum tunneling — analogous to the tunneling through potential barriers in one-dimensional systems — a phenomenon known as dynamical tunneling. WKB analysis reveals that tunneling effects can be expressed in terms of complexified classical dynamics.

We are investigating dynamical tunneling in classically non-integrable systems using WKB analysis and numerical methods. Since the tunneling effect is an exponentially small phenomenon and chaotic dynamics amplifies numerical errors exponentially, we employ high-precision numerical techniques, including arbitrary-precision arithmetic and interval arithmetic.

Keywords: Quantum chaos, complex dynamical systems, WKB analysis, numerical analysis

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