

Time-Evolving Wave Packet in Phase Space

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Abstract : In chaotic billiard systems, scar-like localization has been found on time-evolving wave packet. We may call it the “dynamical scar” to separate it to the original scar in stationary states. It also comes out along the vicinity of classical unstable periodic orbits, when the wave packets are launched along the orbits, against the hypothesis that the waves become homogenous all around the billiard. Then time-evolving wave packets are investigated numerically in phase space. The Wigner function is adopted to detect the wave packets in phase space. The 2-dimensional Poincaré sections of the 4-dimensional phase space are introduced to clarify the dynamical behavior of the wave packets. The Poincaré sections of the coordinate (x or y) and the momentum (Px or Py) can visualize the dynamical behavior of the wave packets, including the behavior in the momentum degree also. For example, in “dynamical scar” states, a bit larger momentum component comes first, and then the a bit smaller and smaller components follow next. The sections made in the momentum space (Px or Py) elucidates specific trajectories that have larger contribution to the “dynamical scar” states. It is the fixed point observation of the momentum degrees at a specific fixed point(x0, y0) in the phase space. The accumulation are also calculated to search the “dynamical scar” in the Poincare sections. It is found the scars as bright spots in momentum degrees of the phase space.

Keywords : chaotic billiard, Poincaré section, scar, wave packet

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