Periodic Orbit Scar in Propagation of Wave Packet

MITSUYOSHI TOMIYA, HIROYOSHI TSUYUKI, SHOICHI SAKAMOTO, Faculty of Science and Technology, Seikei University, ERIC HELLER, Department of Physics, Harvard University — The scar-like enhancement is found in the accumulation of the time-evolving wave packet in stadium billiard. The time-average of the absolute square of the time-evolving wave functions in the stadium billiard is investigated numerically and semiclassically. Nowadays nano- or subnano-sized devices are getting more and more available. This kind of dynamical properties is essential, when the devices actually work. The enhancement appears along an unstable periodic orbit, when the Gaussian wave packet is launched as the initial state along the orbit. Introducing the window function which is closely related to the eigenfunction expansion coefficients of the wave packet, the localization around the periodic orbit is clarified by the semiclassical approximation that it is due to essentially the same mechanism of the scar states in stationary states. The "smooothed" window function is well estimated by the intensity spectrum in Prof. Heller's theory of the long-time semiclassical dynamics. The key parameters that determine its shape are actually classical quantities: the size of the initial wave packet and the Lyapunov exponent.

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