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Chaotic Transport in the Symmetry Crossover Regime with a Spin-orbit Interaction

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We study a chaotic quantum transport in the presence of a weak spin-orbit interaction. Our theory covers the whole symmetry crossover regime between time-reversal invariant systems with and without a spin-orbit interaction. This situation is experimentally realizable when the spin-orbit interaction is controlled in a conductor by applying an electric field. We utilize a semiclassical approach which has recently been developed. In this approach, the non-Abelian nature of the spin diffusion along a classical trajectory plays a crucial role. New analytical expressions with one crossover parameter are semiclassically derived for the average conductance, conductance variance and shot noise. Moreover numerical results on a random matrix model describing the crossover from the GOE (Gaussian Orthogonal Ensemble) to the GSE (Gaussian Symplectic Ensemble) are compared with the semiclassical expressions.

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