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Spin-orbit scattering in quantum diffusion of massive Dirac fermions WENYU SHAN, Wean Hall 6424, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh — We theoretically study the effects of spin-orbit scattering on weak (anti-)localization in two-dimensional massive Dirac systems. We clarify that weak anti-localization and localization of a single massive Dirac cone come from the diffusion of a singlet Cooperon in the massless limit and one of triplet Cooperons in the large-mass limit, respectively. Spin-orbit scattering behaves like random magnetic scattering to the triplet Cooperon, and suppresses the weak localization in the large-mass regime, different from in conventional systems where spin-orbit scattering leads to a crossover from weak localization to antilocalization. This behavior suggests an experiment to detect the weak localization of bulk subbands in topological insulator thin films, in which an enhancement of "weak anti-localization" is expected after doping heavy-element impurities. Finally, we compare the conventional electron and Dirac fermion systems in the quantum diffusion transport under ordinary, spin-orbit, and magnetic scattering.

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