Quantum geometry and semiclassical dynamics in inhomogeneous fields

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We revisit the problem of nonequilibrium semiclassical electron transport in the presence of inhomogeneous external perturbations. For this purpose, we study the quantum geometry of a Bloch band structure beyond the Berry connection contribution. We provide a systematic way of computing the geometric corrections to the semiclassical equations of motion in an N-band system, and extend the notions of Berry phase and quantum geometric tensor to higher orders in the inhomogeneity of the perturbation. We also demonstrate how to derive the dynamics from a generic coupling between Bloch momentum and an inhomogeneous external field, thus generalizing previous studies.