Directed particle flow at zero bias induced by random versus periodic drive

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Using a new developed Single-Electron approach, we derive the Landauer-type formula for electron transport in arbitrary time-dependent potentials. This formula is applied for randomly fluctuating potentials represented by a dichotomic noise. It is found that the noise can induce dc-current in quantum system under zero-bias voltage by breaking the time-reversal symmetry of transmission coefficients. We show that this effect is a result of decoherence, produced by the noise, and therefore can be found in many different systems. In the case of periodic drive, our approach yields the same dc-current in the adiabatic limit, as known in the literature. However, in the asymptotic (steady-state) limit, beyond the adiabatic approximation, our approach predicts no directed net current, but only periodic oscillations of the average current around zero. This result is demonstrated analytically on particular examples and it is proven for general case by using Floquet expansion and time-reversal symmetry of transmission coefficients for time-independent Hamiltonian.