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Microreversibility, current fluctuations, and entropy production in nonequilibrium systems

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On the basis of microreversibility, fluctuation relations are established for the counting statistics of coupled currents flowing across classical or quantum systems sustaining nonequilibrium steady states. Thanks to these relations, the Green-Kubo formulae and the Casimir-Onsager reciprocity relations can be generalized from linear to nonlinear response properties. These advances provide a framework to formulate nonequilibrium thermodynamics in small systems. In this framework, the entropy production can be interpreted as the order parameter of time-reversal symmetry breaking at the statistical level of description. These results apply to hydrodynamic flows, driven Brownian motion, active particles, molecular motors, polymerizations, reactions, as well as to quantum transport in mesoscopic devices.

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