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A theory of nonequilibrium steady states in quantum chaotic systems[1] PEI WANG, Department of Physics, Zhejiang Normal University — Nonequilibrium steady state (NESS) is a quasistationary state, in which exist currents that continuously produce entropy, but the local observables are stationary everywhere. We propose a theory of NESS under the framework of quantum chaos. In an isolated quantum system, there exist some initial states for which the thermodynamic limit and the long-time limit are noncommutative. The density matrix $\hat{\rho}$ of these states displays a universal structure. Suppose that α and β are different eigenstates of the Hamiltonian with energies E_α and E_β, respectively. $< \alpha|\hat{\rho}|\beta >$ behaves as a random number which approximately follows the Laplace distribution with zero mean. In thermodynamic limit, the variance of $< \alpha|\hat{\rho}|\beta >$ is a smooth function of $|E_\alpha - E_\beta|$, scaling as $1/\left|E_\alpha - E_\beta\right|^2$ in the limit $|E_\alpha - E_\beta| \to 0$. If and only if this scaling law is obeyed, the initial state evolves into NESS in the long time limit. We present numerical evidence of our hypothesis in a few chaotic models. Furthermore, we find that our hypothesis implies the eigenstate thermalization hypothesis (ETH) in a bipartite system.

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