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Rigorous results on approach to thermal equilibrium of an optical quantum field mode scattering from the elements of a non-equilibrium quantum reservoir

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Rigorous derivations of the approach of individual elements of large isolated systems to a state of thermal equilibrium, starting from arbitrary initial states, are exceedingly rare. We demonstrate how, through a mechanism of repeated scattering, an approach to equilibrium of this type actually occurs in a specific quantum system.
In particular, we consider an optical mode passing through a reservoir composed of a large number of sequentially-encountered modes of the same frequency, each of which it interacts with through a beam splitter. We analyze the dependence of the asymptotic state of this mode on the assumed stationary common initial state of the reservoir modes and on the transmittance $\tau = \cos\lambda$ of the beam splitters. These results allow us to establish that at small λ such a mode will, starting from an *arbitrary* initial system state, approach a state of thermal equilibrium even when the reservoir modes are not themselves initially thermalized.

Keyword-1

open quantum system

Keyword-2

approach to equilibrium

Keyword-3

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