Thermodynamics of trajectories of a network of quantum harmonic oscillators

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Abstract

The description of the dynamics resulting from the interaction of a quantum system with its environment is one of the key goals of modern quantum physics. Very useful approaches, inspired by specific experimental contexts and exploited with remarkable success, have been developed in the past, such as input–output theory for quantum optics [1], and full counting statistics for fermionic systems [2]. The formal description of the evolution of an open system, on the other hand, is typically tackled through the master equation [3]. Recently, a promising approach came to light, combining the quantum master equation and large-deviation theory [4]. Unlike others, this approach applies to any dissipative quantum systems, paving the way to a standard description of dynamic of open quantum system in terms of thermodynamics of trajectories.
We consider a paradigmatic system in quantum mechanics, quantum harmonic oscillators connected to baths whose dynamics is governed by a quadratic master equation in Lindblad form. This system is a fundamental building block used to describe a large variety of quantum degrees of freedom). I will present how for a single harmonic oscillator, our approach, based on quantum optics methods yields an analytical expression for the large-deviation function en- coding the statistics of exchange between the system and the environment [5]. Furthermore, the same approach, generalised to any network of harmonic oscillator undergoing quadratic dy- namic allows us to, efficiently derive numerically the behaviour of energy-exchange processes between the system and the environment [6].

References

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