THERMODYNAMIC OF TRAJECTORIES FOR QUANTUM HARMONIC OSCILLATORS

S. Pigeon[1,2], L. Fusco[2], A. Xuereb[2,3], G. De Chiara[2], M. Paternostro[2]

(1) Laboratoire Kastler Brossel, UPMC-Sorbonne Universites, CNRS, ENS-PSL Research University, College de France, 4 place Jussieu Case 74, F-75005 Paris, France
(2) Centre for Theoretical Atomic, Molecular and Optical Physics, School of Mathematics and Physics, Queen's University Belfast, Belfast BT7 1NN, UK
(3) Department of Physics, University of Malta, Msida MSD2080, Malta

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. Recently, a promising approach came to light, combining the quantum master equation and large-deviation theory [1]. 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 encoding the statistics of exchange between the system and the environment [2]. Furthermore, the same approach, generalised to any network of harmonic oscillator undergoing quadratic dynamic [3]. From it we can access to possible fluctuation theorem and more generally key thermodynamic quantities such as irreversible entropy produced for a large variety of quantum open systems [3]. We also derive a systematic algorithm to derive, step by step, the full-statistics of the exchange thermodynamics [4].

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