Universidade de São Paulo
Instituto de Física de São Carlos

Semana Integrada do Instituto de Física de São Carlos

13ª edição

Livro de Resumos

São Carlos
2023

Ficha catalográfica elaborada pelo Serviço de Informação do IFSC

Semana Integrada do Instituto de Física de São Carlos
(13: 21-25 ago.: 2023: São Carlos, SP.)
Livro de resumos da XIII Semana Integrada do Instituto de Física de São Carlos – Universidade de São Paulo / Organizado por Adonai Hilário da Silva [et al.]. São Carlos: IFSC, 2023.
358p.

Texto em português.
1.Física. I. Silva, Adonai Hilário da, org. II. Título.

ISSN: 2965-7679

PG8

Dissipative adaptation of driven spin-boson model

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One example of applicability of nonequilibrium statistical physics is to explain how biological systems work. In these systems, the definition of the thermodynamic quantities should be revised to account for the irreversibility of the process. In this scenario, the dissipative adaptation hypothesis (1), proposed by Jeremy England, is a general thermodynamic mechanism that explains system self-organization through the dissipation of work absorbed from an external drive, which acts on the system over a period of time. It establishes how the most likely or adapted states of a system subjected to a given drive tend to be those following trajectories of highest work absorption, followed by dissipated heat to the reservoir. We can think of dissipative adaptation as being a generalization of the Gibbs distribution for systems far from equilibrium. Our idea, is using refs to study the quantum dynamics of a spin-boson systems (a two-level system) with time-dependent external drive and to evaluate the thermodynamic quantities of a self organization process, as absorbed work and heat dissipation. (2-3) In other words, we will have an asymmetric double well potential, after some time a pump of energy is added through a variable that can be chosen according to experimental background or other parameters of the system. Our goal is to show that the drive in an asymmetric potential is able to localize a particle in one of the bottoms of the well and verify that in this transition occurred the highest work absorption followed by dissipation of energy. The relation with these thermodynamic quantities is derived using the path integral approach, introduced by Feynman-Vernon in 1959, which is a description of an open quantum system that has been used to study the dissipative dynamics of the quantum systems, known as the Caldeira-Leggett model of the quantum Brownian motion. (3)

Palavras-chave: Dissipação. Termodinâmica. Spin Boson.

Agência de fomento: CAPES (88887.476110/2020-00)

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