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Quantum thermodynamics of spin echo effect

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The application of refocusing pulses in NMR is a widely used technique to avoid loss of system information due to interaction with the environment. These experiments, known as Spin-Echo effects (1), are considered as an example of behavior of a non-equilibrium system that violates the second law of Thermodynamics, therefore, it is seen that a careful analysis of the Thermodynamics of the problem still needs to be considered. Using Quantum Thermodynamics techniques as a tool, we want to analyze the issue by showing the role of heat, work and entropy production in the Spin Echo protocol. We take as a paradigm a system-environment interaction model associated with a pure dephasing process that, depending on the parameter regime, allows us to observe the emergence of entanglement between the parts. (2) During the decoherence process, the application of the refocusing pulse will be considered, as in the Spin Echo protocol, and its role in reducing the entanglement created, which will impact the return of information to the system. (3) The thermodynamics of the problem will be analyzed through fluctuation theorems and thus we hope to elucidate the production of entropy, recovering a description consistent with the second law of thermodynamics

Palavras-chave: Spin Echo; Pure Dephasing; Quantum Thermodynamics.

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