MASTER IN PHOTONICS – "PHOTONICS BCN"
ERASMUS+ "EUROPHOTONICS-POESII"

MASTER THESIS PROPOSAL

Dates: April - September 2018

Laboratory : Dept. Quantum Physics and Astrophysics
Institution: Universitat de Barcelona
City, Country : Barcelona, Spain

Title of the master thesis: Work distributions in a driven quantum systems

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Keywords : Work in quantum systems, few atom systems

Summary of the subject (maximum 1 page) :

In recent years there has been a tremendous advance in the techniques to trap and control systems of a few bosonic and fermionic atoms [1,2]. In these systems the trap properties are usually tunable, thus allowing one to study how the quantum system adapts to the new trap properties. In particular one can consider a simple scenario in which a particle is trapped in a harmonic oscillator potential which trapping frequency is varied in time with a given time dependence. This system represents a simple example where the concepts of work [3] need to be adapted to quantum mechanical descriptions [4].

In the present master thesis we will study the work distribution function for different functional variations of the trapped geometries, starting from the harmonic oscillator case but also considering other geometries. The concept of irreversible work is directly linked to the adiabaticity of the process. Thus, our idea is to devise controlled variations of the parameters which minimize the irreversible work during the process.

Bibliography:

[1] Deterministic Preparation of a Tunable Few-Fermion System
F. Serwane, G. Zürn, T. Lompe, T. B. Ottenstein, A. N. Wenz and S. Jochim
Science Vol. 332. no. 6027, (2011); arXiv:1101.2124

[2] Measuring entanglement entropy in a quantum many-body system
R. Islam, R. Ma, P. M. Preiss, M. E. Tai, A. Lukin, M. Rispoli, M. Greiner
Nature 528, 77-83 (2015).

[3] C. Jarzynski, Phys. Rev. Lett. 78, 2690 (1997).

[4] Nonequilibrium work distribution of a quantum harmonic oscillator
S Deffner, E Lutz, Physical Review E 77, 021128 (2007)

Additional information :
* Required skills :
Quantum mechanics, many-body quantum mechanics, computational physics.

* Miscellaneous :