SEMINARIO
Departamentos de Física Teórica I y II
Universidad Complutense de Madrid

INVITADO: Adolfo del Campo

Theoretical Division and Center for Nonlinear
Studies, Los Alamos National Laboratory, USA

TITULO: Shortcuts to adiabaticity in many-body systems

LUGAR: FACULTAD DE CIENCIAS FÍSICAS UCM
DÍA: 15 de enero, 2013 (Martes)
HORA: 14:30
AULA: Seminario Depto. Física Teórica I, Planta 3ª

ABSTRACT

This talk is a "tapas selection", reviewing recent advances in the design of shortcuts to adiabaticity in many-body systems.
- Adiabatic invariants, and the inversion of dynamical scaling laws, will be applied to trapped ultracold gases [1-3]. In particular, a proposal will be discussed to drive controlled expansions in which quantum correlations are preserved, essentially realizing a quantum dynamical microscope [2,3].
- Controlling the dynamics through a quantum phase transition implies an additional challenge: to prevent the formation of excitations in spite of the critical slowing down in the neighborhood of the critical point. According to the Kibble-Zurek mechanism, in inhomogeneous systems with a spatially varying critical point, whenever the speed of the spatial front crossing the transition is lower than the sound velocity excitations can be completely suppressed [4,5]. Experimentally, this scenario has recently been demonstrated in ion Coulomb crystals [6].
- An alternative approach in quantum critical systems exploits recent advances in the simulation of coherent k-body interactions and transitionless quantum driving [7]. This method is ideally suited to access the ground state manifold in quantum simulators.

- Finally, a generalized time-energy uncertainty relation will be introduced, applicable to both isolated and open quantum systems. This relation constitutes a fundamental quantum speed limit for any dynamical process [8].

REFERENCES:

1. X. Chen, A. Ruschhaupt, S. Schmidt, A. del Campo, D. Guery-Odelin, J. G. Muga, Fast optimal frictionless atom cooling in harmonic traps, Phys. Rev. Lett. 104, 063002 (2010) .
2. A. del Campo, Frictionless quantum quenches in ultracold gases: a quantum dynamical microscope, Phys. Rev. A 84, 031606(R) (2011) .
3. A. del Campo, M. G. Boshier, Shortcuts to adiabaticity in a time-dependent box, submitted, Sci. Rep. 2, 648 (2012).
4. A. del Campo, G. De Chiara, G. Morigi, M. B. Plenio, A. Retzker, Structural defects in ion crystals by quenching the external potential: the inhomogeneous Kibble-Zurek mechanism, Phys. Rev. Lett. 105, 075701 (2010) .
5. G. De Chiara, A. del Campo, G. Morigi, M. B. Plenio, A. Retzker, Spontaneous nucleation of structural defects in inhomogeneous ion chains, New J. Phys. 12, 115003 (2010) .
6. K. Pyka, J. Keller, H. L. Partner, R. Nigmatullin, T. Burgermeister, D. M. Meier, K. Kuhlmann, A. Retzker, M. B. Plenio, W.H. Zurek, A. del Campo, T. E. Mehlstäubler, Symmetry Breaking and Topological Defect Formation in Ion Coulomb Crystals, arXiv:1211.7005
7. A. del Campo, M. Rams, W. H. Zurek, Assisted finite-rate adiabatic passage across a quantum critical point: Exact solution for the quantum Ising model, Phys. Rev. Lett. 109, 115703 (2012)
8. A. del Campo, I. L. Egusquiza, M. B. Plenio, S. F. Huelga, Quantum speed limits in open system dynamics, Phys. Rev. Lett. (TBP), arXiv:1209.1737