UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI FISICA

Thursday, 06 November
Aula Polvani

feeding the future with quantum technology

Quantum EXPO

University of Milan - Department of Physics

Paola Verrucchi

ISC-CNR and Università di Firenze

Parametric representation of open quantum systems

Scheduled at 11:00

Abstract: Quantum systems with an environment are referred to as open quantum systems (OQS). The description of an OQS in terms of the corresponding reduced density matrix is axiomatically exact and fully retains the quantum character of the environment, making it the preferred approach. However, there exists another description of OQS, where the principal system is in a pure state, but under the effect of a local Hamiltonian depending on "external" parameters, whose presence testifies to the existence of a surrounding environment. At the heart of this approach stands the approximation that the environment is classical, so that the operators acting on its Hilbert space are replaced by c-number parameters. Therefore, the interaction Hamiltonian is reduced to an effectively local one for the sole principal system. In the two approaches, the environment is either quantum or classical. In this seminar I will describe a recently introduced method for studying OQS that allows to follow the crossover between a quantum description of the environment and its classical limit, without affecting the quantum nature of the principal system. The method stems from a representation of OQS in terms of pure states that parametrically depend on continuous variables. These variables are in one-to-one correspondence with specific environmental coherent states, which formally reflects the interplay between the principal system and its environment. After having shown how to generally construct the above parametric representation, and commented upon its essential features, I will specifically set it in the framework of OQS dynamics, and finally use it for describing the dynamical process underlying decoherence and the measurement process.

"Young scientist seminar"
(scheduled at 11:50)

Jacopo Trapani

University of Milan

The quantum-to-classical transition for a harmonic oscillator interacting with a classical environment

Lorenzo Campos-Venuti

University of South California

Time-fluctuations in out-of-equilibrium closed quantum systems

Scheduled at 14:30

Abstract: Out of equilibrium quantum systems, on top of quantum fluctuations, display complex temporal patterns. In this talk the theory of such temporal fluctuations will be presented. We will show that a wealth of precious information is encoded in the temporal fluctuations, such as the ability to detect integrability, criticality and to characterize atomic condensates. In the typical case time fluctuations are exponentially small in the system volume and can be therefore safely ignored. This result does not hold for integrable systems and at criticality and these cases will be considered in detail.

For integrable systems we show that temporal fluctuations will be Gaussian. In this case the relative fluctuations decay in the volume with the familiar $1/\sqrt{V}$ law as opposed to exponentially. This is a precise characterization of the common folklore according to which integrable systems equilibrate poorly. The critical scenario will be analyzed in the context of the so called quench experiment where a perturbation is applied suddenly. In the limit of small quench, time fluctuations become stronger than other forms of equilibrium quantum fluctuations if the quench is performed close to a critical point. For sufficiently relevant operators the full distribution function of dynamically evolving observable expectation values, becomes a universal function uniquely characterized by a single critical exponent and the boundary conditions. This shows that critical temporal fluctuations are even more universal than equilibrium ones. Applications of these findings to trapped optical lattices will be discussed.

Further information at the page: http://users.unimi.it/aqm