UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI FISICA

Wed, 24 Feb 2015
Aula Polvani

feeding the future with quantum technology

Quantum EXPO

University of Milan - Department of Physics

Stefano Mancini

Università di Camerino **At 11:00**

Entanglement assisted feedback control

Abstract: In this talk I will survey recent developments about the theory of feedback control for bosonic quantum systems. In particular I will address the issue of taking such systems, subject to quadratic Hamiltonians and a noisy thermal environment, to nonclassical stationary states by feedback loops based on continuous weak measurements and conditioned linear driving. I will derive general analytical upper bounds for the single-mode squeezing and multimode entanglement at steady state, depending only on the Hamiltonian parameters and on the number of thermal excitations of the bath. Surprisingly, these findings show that larger number of thermal excitations in the bath allow for larger steady-state squeezing and entanglement. Drawing from the notion that the thermal state of the environment may be regarded as the local state of a lossy and noisy two-mode squeezed state, I will consider conditional dynamics (*unravellings*) interpolating between direct detection of the environmental mode alone and full access to the purification of the bath. This latter case can be regarded as feedback control assisted by entanglement and it allows us to attain the above mentioned upper bounds on stationary squeezing and entanglement.

Michele Avalle

At 11:50

UCL London

Transport process and typicality of noisy quantum systems with discrete time

Marco G. Genoni

At 14:30 **UCL London**

Cooling and squeezing generation for a levitated nanosphere via time-continuous measurements

Abstract: We consider a levitated dielectric nanosphere trapped in an optical cavity and study the conditional dynamics induced by simultaneous sideband cooling and time-continuous measurement of both the output cavity mode and the nanosphere's position. We observe that the continuous monitoring of the system, together with Markovian feedback, allows to stabilize the dynamics for all the values of the laser frequency driving the cavity. In particular we discuss the properties of the corresponding steady-states, by focusing on their average phonon number, purity and quantum squeezing, and find that, for all these figures of merit, the performances are greatly improved when sideband cooling is accompanied with time-continuous measurements. Finally we analyse in detail the results for a particular experimental setup, where the nanosphere is trapped only by the field of the high finesse cavity. By considering state-of-the-art values of the experimental parameters, we prove that one can in principle obtain a non-classical (squeezed) steady-state with an average phonon number n=0.5.