ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΦΥΣΙΚΗΣ

CRETE CENTER FOR QUANTUM COMPLEXITY AND NANOTECHNOLOGY

ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

Thursday, 28 November 2013

17:00 -18:00

3rd Floor Seminar Room

"Communication and sensing beyond standard quantum limits"

Prof. Eugene Polzik

Niels Bohr Institute, Copenhagen University

Abstract

Quantum mechanics poses a limit on the measurement precision, the Standard Quantum Limit (SQL), through the Heisenberg uncertainty principle. Non-commuting operators, such as position and momentum, or two components of a spin cannot be determined simultaneously. There are, however, allowed operations with the precision beyond the SQL. One example is quantum teleportation. We have proposed and demonstrated a deterministic teleportation between spin states of distant material objects[1]. The objects are macroscopic atomic ensembles at room temperature. Entanglement required for teleportation is distributed by light propagating from one ensemble to the other. We demonstrate stroboscopic teleportation of a sequence of spin states evolving in time and propose the way to simulate interaction between remote systems[2]. The second example of an operation beyond the SQL of precision is the measurement of a disturbance applied to an atomic spin. The seemingly impossible task of the measurement of, in principle, arbitrary small disturbances of two non-commuting spin projections is achieved through entanglement of the spin with a reference system acting as an oscillator with a negative frequency[3].

1. Deterministic quantum teleportation between distant atomic objects. H. Krauter et al. Nature Physics (2013) doi:10.1038/nphys2631.
2. Quantum teleportation of dynamics and effective interactions between remote systems. C. A. Muschik et al. Phys. Rev. Lett., 020501, 111 (2013).
3. Quantum noise limited and entanglement-assisted magnetometry. W. Wasilewski et al. Phys. Rev. Lett., 104, 133601 (2010).