Chez Pierre

Presents ...

Tuesday, March 1, 2011

11:00 am

MIT Room 4-331

SPECIAL CHEZ PIERRE SEMINAR

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Caltech

"Quantum Optomechanics: New Paradigms and Applications"

In recent years, systems consisting of nano- or micro-mechanical resonators coupled to high-finesse optical cavities have emerged as promising platforms to observe and manipulate quantum behavior at increasingly large scales. While there have been a number of remarkable theoretical and experimental developments, at least two major open questions remain:

a) How can these systems be sufficiently isolated from the environment (as characterized, for example, by the mechanical Q-factor) to manipulate increasingly complex quantum behavior? and **b)** What real-world applications might arise from these efforts?

I will discuss our efforts to approach these questions, which are inspired by recent exciting advances in atomic physics. In the first half of my talk, I will discuss the connection between optical trapping of atoms and the use of optical forces to engineer novel types of mechanical motion. In particular, we show that new mechanical modes can emerge whose quality factors can far exceed "established" material limits such as thermoelastic damping. These ultrahigh-Q modes should open up a viable route to quantum optomechanics even in room-temperature environments.

In the second half of my talk, I will discuss our ideas to realize tunable optical delay lines, quantum memories for light, and single-photon nonlinearities using optomechanical systems. Combining these elements together would potentially enable optomechanical systems to become a viable alternative to atomic systems for optical quantum information processing. I will also focus on one realistic physical system, an "optomechanical crystal," which can be realized on a compact and highly configurable on-chip platform.