

Joint Quantum Institute Seminar
March 31, 2008 at 12:30
Physics 1201

“Controlling single nuclei and lighting nanowires:
new frontiers of quantum optical science”

Mikhail Lukin
Harvard University

Controlling quantum behavior of light and matter is an outstanding challenge in modern science and engineering. It is at the heart of many modern developments in an emerging interface involving quantum optics and quantum information science, mesoscopic physics, nano-science and many-body physics of strongly correlated systems. Two examples of these developments will be described in this talk.

Specifically, we will discuss our recent work involving the controlled manipulation of individual nuclear spins in a high-purity diamond lattice. Our approach combines ideas from single molecule spectroscopy, quantum optical control techniques and the physics of mesoscopic spin ensembles. It allows us to isolate, polarize and manipulate single nuclear spins and use them to create quantum memory and small quantum registers with exceptional coherence properties, even under ambient room temperature conditions.

We will also describe a novel approach to controlling light-matter interactions that make use of sub-wavelength localization of optical fields on metallic nano-sized wires. This approach combines the ideas of quantum optics with those of electronics and plasmonics.

Looking forward, we will describe novel applications of these techniques. These include single photon nonlinear optics and strongly interacting many-body systems of photons, new approaches to quantum communication and computation as well as new quantum magnetic sensors with nanoscale resolution.

Host: Luis Orozco