

Chez Pierre

Presents ...

Tuesday, February 21, 2012

12:00pm

MIT Room 4-331



SPECIAL CHEZ PIERRE SEMINAR

Maiken H. Mikkelsen

University of California, Berkeley

"Spintronics & Nanophotonics for Quantum Information Science"

Individual semiconductor quantum dots are attractive systems for the study of fundamental spin dynamics, light-matter interactions, and quantum information applications. A key ingredient for spin-based quantum information processing is the coherent rotation of a spin-state on timescales much faster than the spin coherence time. To achieve this, off-resonant optical pulses are used to create a large effective magnetic field via the optical Stark effect, allowing the coherent rotation of a single electron spin in a quantum dot through arbitrary angles up to π radians in 30 ps [1]. Non-destructive time-resolved Kerr rotation is used to directly monitor the electron spin dynamics and in addition serves as a sensitive probe of the local nuclear spin environment [2,3]. These experiments demonstrate the sequential initialization, ultrafast manipulation, and detection of a single electron spin in GaAs quantum dot. One of the next challenges for quantum information applications is the creation of on-chip quantum networks. A step towards this goal is the integration of single emitters with nanophotonic structures. Recent experiments demonstrate efficient coupling of a single CdSe/ZnS quantum dot to a deep-subwavelength waveguide revealing strongly enhanced light-matter interactions [4]. These results represent progress towards the implementation of scalable quantum information processing in the solid state.

[1] J. Berezovsky*, M. H. Mikkelsen*, N. G. Stoltz, L. A. Coldren & D. D. Awschalom, *Science* 320, 349 (2008)

[2] M. H. Mikkelsen, J. Berezovsky, N. G. Stoltz, L. A. Coldren & D. D. Awschalom, *Nature Physics* 3, 770 (2007)

[3] J. Berezovsky, M. H. Mikkelsen, O. Gywat, N. G. Stoltz, L. A. Coldren & D. D. Awschalom, *Science* 314, 1916 (2006)

[4] M. H. Mikkelsen*, N. Pholchai*, P. Kolchin*, J. Oh, M. S. Islam & X. Zhang, in preparation