Friday, May 13, 2011
Speaker: Richard Norte, Painter group
Title: Optical Trapping of Nano-Membranes

Integrating a high mechanical-Q oscillator to a high-finesse cavity for cavity optomechanics cooling is a promising way to observe quantum coherence in macroscopic objects. Our work currently focuses on improving the mechanical-Q of the oscillator by optically trapping suspended dielectric membranes. We push the limits of nanofabrication in order to free the membranes from contact to the environment as much as possible. We use light to optically stiffen the center-of-mass motion of these membranes and hope to increase the Q of the system by storing energy in “lossless” optical field. I will discuss our progress on design simulations, fabrication, and experimental evidence of optical trapping of these membranes. In the future, we plan to integrate our oscillator inside a high finesse cavity for further cooling.

Friday, May 20, 2011
Speaker: Aaron Finck, Eisenstein Group
Title: Exciton Transport in a Bilayer Quantum Hall System

For small interlayer separation, a bilayer two-dimensional electron system at total Landau filling factor one (\nu_T=1) can form a quantum Hall state with strong interlayer correlations. Although the \nu_T=1 quantum Hall system can described using the language of exciton condensation, there has so far been only indirect experimental evidence for its excitonic nature. For example, previous studies have found that counterflowing currents (currents of equal magnitude but oppositely directed in the two layers) result in a vanishing Hall resistance at \nu_T=1. This is consistent with exciton transport because counterflowing currents could be transported by a unidirectional flow of neutral excitons, which experience no Lorentz force. However, these studies used samples with a Hall bar topology, in which all contacts are on the same edge of the \nu_T=1 system and are connected by charge-carrying edge channels common to all quantum Hall systems. Therefore, the interpretation of such experiments are complicated by these edge channels and they cannot directly demonstrate *bulk* exciton transport. Here we describe a recent experiment using a Corbino geometry with contacts on two separate edges, thus allowing us to probe the bulk conductance of the bilayer system. We unambiguously demonstrate that counterflowing electrical currents can propagate through the bulk at \nu_T=1, even as parallel currents cannot. We show that deep in the excitonic phase counterflowing currents allow the transport of energy across the insulating bulk without a net transfer of charge. We also find evidence that the conductance of counterflowing currents exceeds that of parallel currents even at elevated temperatures, when the bulk is not fully insulating.

Friday, May 27, 2011
Speaker: Alexey Gorshkov, IQI
Title: Photon-Photon Interactions via Rydberg Blockade

We develop the theory of light propagation under the conditions of electromagnetically induced transparency (EIT) in systems involving strongly interacting Rydberg states. Taking into account the quantum nature and the spatial propagation of light, we analyze interactions involving few-photon pulses. We demonstrate that this system can be used for the generation of nonclassical states of light including trains of single photons with an avoided volume between them, for implementing photon-photon quantum gates, as well as for studying many-body phenomena with strongly correlated photons. [Reference: arXiv:1103.3700]

Friday, June 3rd, 2011
Speaker: Martin Winger, Painter Group
Title: Tunable 2d photonic crystal cavities for cavity electro-optomechanics

Photonic crystal microcavities have found numerous applications in cavity QED, photonics, and more recently in cavity optomechanics due to their potential to confine light on length scales comparable to the optical wavelength. While straightforward on-chip integration presents one of their biggest advantages, it also makes frequency tuning of the optical resonances intrinsically difficult. In my talk I will present a novel electro-mechanically tunable photonic crystal cavity, where a mechanical degree of freedom can be directly accessed using capacitive actuators, thus leading to wide-range, fast, and reversible cavity tuning. At the same time, optomechanical feedback can be used for efficient noise reduction. I will discuss the design, fabrication, and experimental study of such a device, and outline how we expect to use it in future experiments at the interface between microwave electronics and optics.

Friday, June 10, 2011
Speaker: Professor Aash Clerk, McGill University
Title: QND measurement of phonon & photon shot noise: full statistics

A key goal in the field of quantum optomechanics is to measure truly quantum behaviour in a "large" mechanical resonator. One approach being actively pursued is to detect evidence of mechanical energy quantization via a QND measurement. In this talk, I will start by giving a quick introduction to optomechanics. I will then discuss recent experimentally-motivated theoretical work which calculates the full statistics of low-frequency energy fluctuations of a driven, quantum resonator. Surprisingly, these fluctuations are highly non-classical: they are most naturally described by a quasi-probability distribution which can be negative. This is analogous to the statistics of electronic charge transfer (so-called "full counting statistics") in superconducting system. I will discuss how these effects might be measured, and how they represent a kind of non-classical behaviour similar to the violation of a Leggett-Garg inequality. While the emphasis is on phonons, our results apply equally as well to the photon fluctuations of a driven cavity.

Friday, June 17, 2011
Speaker: Hsin-Hua Lai, Condensed Matter Theory
Title: Ladder descendant of the 2 dimensional gapless quantum spin liquid and beyond

In this talk, I will mainly talk about the 2-leg ladder descendant of the 2 dimensional gapless quantum spin liquid called "spin Bose-metal" motivated by recent experimental realization of the gapless spin liquid state in the triangular lattice based organic "weak Mott insulator" \kappa-(ET)_2Cu_2(CN)_3 (\kappa-(ET)) and EtMe_3Sb[Pb(dmit)_2]_2 (DMIT). In general, such spin Bose-metal can be accessed from either quantum spin model and Hubbard-type model and due to the presence of Zeeman magnetic field, possible exotic spin-liquid phases with spin-nematic order can arise.

Friday, June 24, 2011
Speaker: Professor John Close - Department of Quantum Science, The Australian National University
Title: Comparing thermal and lasing (BEC based) atomic sources for precision inertial measurement

In principle, a light bulb and laser that have the same photon flux will yield the same precision in many shot noise limited optical measurements. In practice, it is the classical properties of optical lasers, their brightness, coherence, and low phase and amplitude noise that enable a shot noise limited optical measurement to be achieved at high flux. In atom optics, high-brightness lasing atomic sources based on Bose Einstein condensates (BECs) have not been widely adopted by the precision measurement community due to low flux and due to the assumption that their comparatively high density will lead to dephasing that can limit precision. In this talk, I present the first experimental and theoretical comparison between a thermal atom inertial sensor and an atom-laser based inertial sensor. We find that dephasing in an expanded BEC and in atom laser sources will not limit the precision of inertial measurements at and beyond current state-of-the-art sensitivity. Large momentum transfer (LMT) beam-splitting with lasing sources gives higher fringe visibility in our apparatus and potentially higher flux contributing to the interferometer signal than thermal sources. As is commonly the case in optical interferometry, we observe a significant increase in visibility when using a lasing atomic source instead of a thermal one in an identical setup.

Wednesday, July 6, 2011
Speaker: Chen-Lung Hung, University of Chicago
Title: In situ study of scaling behavior in two-dimensional Bose gases

High resolution in-situ imaging of ultracold atoms confined in a two dimensional (2D) trap reveals precise information on in-trap density distribution and density fluctuations. From density measurements we determine the equation of state through the assumption of the local density approximation; fluctuation measurements reflect the density-density correlation in quantum gases and its growth near a continuous phase transition. The in-situ imaging technique opens up exciting opportunities to study critical behavior in the phase transition region in two dimensions, such as the fluctuation region near the Berezinsky-Kosterlitz-Thouless transition and the quantum critical region near the superfluid-Mott insulator phase boundaries in a 2D optical lattice. In this talk, I will present our study on global scale-invariance and universality in weakly interacting 2D Bose gases. I will further discuss the analysis of extracting the static structure factor of a 2D gas from its density-density correlations, and the exploration of quantum critical scaling in optical lattices.

Friday, July 8, 2011
Speaker: Darrick Chang, IQI
Title: Single-photon nonlinear optics via strong field confinement

Achieving large nonlinear interactions between single photons would be an important step toward both classical and quantum all-optical information processing. While a wide variety of bulk nonlinear optical materials exist that are robust and find everyday use (such as in laser frequency conversion), the per-photon interaction strengths are typically very weak, meaning that large input powers are needed to make nonlinear phenomena observable. Here, I will discuss how extremely tight spatial field confinement may enhance interactions to the point that even single photons can interact strongly. I will also discuss a possible implementation involving surface plasmon excitations in graphene, which in principle can be focused down to volumes a million times smaller than allowed by the diffraction limit in free space.

Friday, July 15, 2011
Speaker: Kyung Soo Choi, Kimble Group
Title: Entanglement of spin waves among four quantum memories

The physical realization of quantum networks generically requires dynamical systems capable of generating and storing entangled states among multiple quantum memories, and efficiently transferring stored entanglement into quantum channels for distribution across the network. Although such capabilities have been demonstrated for diverse bipartite systems, entangled states have not been achieved for interconnects capable of mapping multipartite entanglement stored in quantum memories to quantum channels. In this talk, I will discuss a recent experiment [1], where we demonstrate measurement-induced entanglement stored in four atomic memories; coherent transfer of the atomic entanglement to four photonic channels; and characterization of the full quadripartite entanglement using quantum uncertainty relations. Our work therefore constitutes an advance in the distribution of multipartite entanglement across quantum networks. We also show that our entanglement verification method is suitable for investigating the entanglement order of condensed-matter systems in thermal equilibrium. With regards to quantum measurements, the multipartite entangled spin-wave may be applied for sensing an atomic phase shift beyond the limit for any unentangled state. Finally, I will briefly describe our on-going work for trapping and interfacing neutral atoms with state-insensitive two-color evanescent waves surrounding a nano-fiber.

[1]. K. S. Choi, A. Goban, S.B. Papp, S. J. van Enk and H. J. Kimble, *Nature* **468**, 412 (2010); available as quant-ph 1007.1664v1 9 July 2010.

Friday, July 22, 2011
Speaker: Doron Bergman, Condensed Matter Theory
Title: The topological insulator in a Fermi sea - sink or swim?

In the flurry of experiments looking for topological insulator materials, it has been found that some bulk metals very close to topological insulator electronic states support the same topological surface states that are the defining characteristic of the topological insulator. First observed in spin-polarized angle resolved photoemission spectroscopy (ARPES) in Sb [D. Hsieh et al., Science 323, 919 (2009)], the helical surface states in the metallic systems appear to be robust to at least mild disorder. We present an investigation of the nature of these "topological conductors"- bulk metals with helical surface states. We explore how the surface states can survive the insulator being turned into a metal, in both clean and disordered systems. We also explore magnetoelectric coupling phenomena in these systems, which turn out to realize an analog of the intrinsic anomalous Hall effect.

Friday, July 29, 2011
Speaker: Matt Shaw, Schwab Group
Title: Toward the preparation and detection of squeezed states in a mechanical oscillator

Recent advances in nanofabrication technology and measurement techniques are now allowing experimenters around the world to access the quantum regime in mechanical systems, with profound implications for fundamental science, quantum information technology, and precision measurement and control. In this seminar, I will describe our recent efforts toward the preparation and detection of squeezed states in a strongly coupled electromechanical system, where the fluctuations in one quadrature of mechanical motion can be suppressed below the standard quantum limit through quantum non-demolition measurements and feedback. To realize this experiment, we have recently fabricated superconducting NbTiN membrane resonators coupled to on-chip microwave cavities without any amorphous dielectrics or lossy superconductors. Such devices can also be used to implement a wide variety of new experiments in cavity electromechanics.

Friday, August 5, 2011
Speaker: Daniel Alton, Kimble Group
Title: Cavity QED with microtoroidal optical resonators

Quantum control of strong interactions between a single atom and one photon has been achieved within the setting of cavity quantum electrodynamics [1]. To move beyond proof-of-principle experiments involving one or two conventional optical cavities to more complex scalable systems that employ N >> 1 microscopic resonators requires localization of atoms on distance scales ~100 nm from a resonator's surface, where atom-surface interactions are significant. I will talk about our recent experiment [2] where we access this new regime of cavity QED and briefly discuss our on-going effort to trap single atoms in such setting using a tapered nano-fiber.

[1] H.J. Kimble, Nature 453, 1023, 2008.

[2] D.J. Alton, N.P. Stern, T. Aoki, H. Lee, E. Ostby, K.J. Vahala, H.J. Kimble, Nature Phys. 7, 159, 2011.

Friday, August 12, 2011
Speaker: Steve Flammia, IQI
Title: Verification and Characterization of Quantum States and Processes

Recent years have witnessed tremendous progress in laboratory experiments which prepare highly entangled states of quantum many-body systems. As the complexity of these states increases, however, so too does the difficultly in verifying the quality of the experiment by some objective measure, and in characterizing any undesired noise processes therein. In this talk I will discuss several new methods which address both tasks -- verification and characterization -- using far fewer resources than traditional methods. I will show how ideas from compressed sensing can be adapted to learn a nearly pure quantum state or nearly unitary quantum process using quadratically fewer measurement settings than traditional methods, an improvement which is provably optimal. Next, I will show how ideas from quantum information theory and condensed matter physics allow us to efficiently learn the ground states of local Hamiltonians of gapped one-dimensional interacting quantum systems in polynomial time in the number of systems. Finally, I will show how to directly verify the quality of an experiment (as quantified by the fidelity or process fidelity with respect to some ideal process) using only a constant number of measurement settings, independent of the size of the system.

Friday, August 19, 2011
Speaker: Bill Chickering, Eisenstein Group
Title: Thermopower of 2D electrons in the first excited Landau level

When a magnetic field is applied perpendicular to a high-mobility 2D electron system its kinetic-energy spectrum quantizes into a discrete set of highly degenerate Landau levels. At low temperatures and high magnetic fields, minimization of the electron-electron Coulomb repulsion results in a rich variety of correlated many-body phases that include incompressible fractional quantized Hall states, compressible composite fermion metallic phases, as well as insulating charge density waves. In this talk I will discuss our ongoing efforts to probe the exotic collective behaviors of such systems through measurements of thermopower. The primary focus of our study is on the first excited Landau level including the incompressible fractional quantized hall state at filling factor 5/2 as well as insulating phases associated with reentrant integer quantized hall effects. Particular emphasis will be given to experimental details and challenges.

Friday, August 26, 2011
Speaker: Amir Safavi-Naeini, Painter Group
Title: Measuring the quantum zero-point motion of a mechanical resonator

The Heisenberg uncertainty principle, one of the fundamental consequences of quantum theory, restricts the simultaneous certainty with which the position and momentum of an object may be known and defined. A particle confined to a potential, will thus possess a non-zero energy due to random quantum fluctuations of its position. For the mechanical systems of our daily experience, these quantum fluctuations are usually masked by thermal noise resulting from interaction with the environment. To observe this quantum motion on a mesoscopic system, the dual and antagonistic feats of isolating a mechanical system from its environment, while measuring its position with great sensitivity must be achieved. Recently, electro- and optomechanical systems consisting of simultaneous electromagnetic and mechanical resonators have been cooled into their quantum ground states, by a combination of cryogenic pre-cooling and radiation pressure back-action. Additionally, these transducers can be made exquisitely sensitive to mechanical motion, and have been long used for precision metrology.

In this talk I will present a quick overview of optomechanics and its application to quantum information, followed by recent unpublished results from our experiments on optically probing the motion of a Silicon-based mechanical resonator near its quantum ground state. By comparing the intensity of scattered blue- (anti-Stokes) and red-shifted (Stokes) probe sidebands we observe an asymmetry (n/n+1) providing a direct measurement of the phonon occupation number, and demonstrating the quantum zero-point motion of a mesoscopic mechanical resonator.

Friday, September 2, 2011
Speaker: Liang Jiang, IQI
Title: Long-Lived Solid-State Room-Temperature Quantum Memory

One of the major obstacles in quantum information technology is to prevent a quantum bit (qubit) from decoherence, while still being able to reliably manipulate and readout the qubit. In the talk, I will show recent results towards the realization of a room temperature quantum register that maintains its quantum mechanical nature for almost one second while still allowing for reliable qubit manipulation and high fidelity readout. To achieve this, we utilize a quantum register consisting of an electronic ancilla spin and a proximal nuclear memory spin; the register is associated with single nitrogen-vacancy (NV) defect centers in diamond. The realization of a solid state quantum memory with long coherence times at room temperature opens up new possibilities for applications of quantum information systems.

Friday, September 9, 2011
Speaker: Netanel Lindner
Title: Topological phenomena in driven systems

Topological phases of matter have captured our imagination over the past few years. Despite recent advancements in the field, our ability to control topological transitions remains limited, and usually requires changing material or structure properties. We show that a topological state can be induced in a semiconductor quantum well, initially in the trivial phase, by irradiation with microwave frequencies, without changing the well structure, closing the gap and crossing the phase transition. We show that the quasi-energy spectrum exhibits helical edge states.
We discuss the necessary experimental parameters for our proposal. This proposal provides an example and a proof of principle of a new non-equilibrium topological state: a ``Floquet topological insulator''.

Friday, September 16, 2011
Speaker: Dalziel Wilson, Kimble Group
Title: Optomechanics with SiN films at 300 K

A nanomechanical oscillator coupled to a high finesse optical cavity provides a delicate tool for interacting phonons and photons. In this setting, a challenging goal is to use light to prepare and observe quantum fluctuations of a mesoscopic oscillator at room temperature, which places stringent demands on the oscillator's quality factor and frequency. I will present progress towards this goal in our system composed of an ultra-thin, high stress Silicon Nitride film coupled to short, high finesse Fabry-Perot resonator. We have demonstrated that these films can support > 1 MHz drum modes with quality factors in excess of 7×10^6 and Q-frequency products in excess of 3×10^{13} Hz, as well as low optical absorption characterized by $Im(n) < 10^{-5}$ at 935 nm. When coupled to the cavity, 100 microwatts of radiation has been used the sideband-cool a higher order drum mode of the film to ~500 phonons, limited by technical noise on the intensity of the intracavity field. I'll describe future prospects for our system, including a technique we've developed to actively suppress intracavity intensity noise using feedback.

Background material may be found in:
[1] D.J. Wilson, C.A. Regal, S.B. Papp, H.J. Kimble, Phys. Rev. Lett. 103, 207204 (2009)

Friday, September 23, 2011
Speaker: Prabha Mandayam, IQI
Title: Approximate Quantum Error Correction

The discovery of quantum error correcting (QEC) codes has played an important role in making the exciting theoretical idea of quantum information processing into a physically realizable prospect. Moving away from the standard notion of 'perfect' error correction, recent investigations have opened up the possibility of 'approximate' quantum codes of shorter length, that recover the information with fidelity comparable to that of perfect QEC codes.

In this talk we describe a universal, near-optimal recovery map -- the transpose channel -- for approximate quantum error-correcting codes, with optimality defined in terms of a worst-case fidelity measure. We show that the transpose channel provides an alternative interpretation of the standard QEC conditions, naturally leading to conditions for approximate quantum error correction. Our analytical results offer a significant departure from earlier approaches to this problem, which have mostly focused on exhaustive numerical searches to find the optimal recovery map for specific noise channels. For example, we demonstrate good approximate QEC codes for the amplitude damping noise channel, which correct with fidelity comparable to the numerically optimized codes and the shortest perfect code. Finally, we show that our approach based on the transpose channel can be generalized to the case of subsystem codes, thus providing a unifying framework for approximate QEC.

(Reference: H.K. Ng and P. Mandayam, Phys. Rev. A, 81, 62342, (2010))

Friday, October 7, 2011
Speaker: Scott Kelber, Roukes group
Title: Matrix Assisted Laser Desorption Ionization Mass Spectrometry with a Nano-Electromechanical System (MALDI-NEMS)

Mass Spectrometry is a rapidly evolving field for the study of a wide variety of organic and inorganic compounds such as minerals, isotopes, peptides, proteins, and even whole cells. Current methodologies rely on the ionization of target species and measurement of their mass-to-charge (m/z) ratio. Employing nano-scale mechanical resonators, we have developed a mass spectrometer that performs a direct mass measurement of the target species. Using the MALDI mass spectrometry technique, we have measured individual gold nanoparticles at sizes of 5nm and 10nm (diameter). Early attempts at measuring proteins and viruses are discussed and an outlook given for future experiments.

Friday, October 14, 2011
Speaker: Isaac Kim, IQI
Title: Local qupit error correcting code on a 3D cubic lattice

Recently Haah introduced a new class of local quantum error correcting code embedded on a cubic lattice without any string logical operator. We present a family of quantum codes with seemingly similar properties. The code is well-defined whenever the dimension of the local particle p is a prime number, but the behavior of the code changes drastically as p changes. For instance, when p=2,5 the resulting quantum code contains a string logical operator. Numerical evidence shows that other values of p might forbid the existence of string logical operator. Logical operators in these cases are either non-contractible surface or a fractal. We establish a lower bound on the number of encoded qupits by constructing surface logical operator and their commutation relations.

Friday, October 21, 2011
Speaker: Erik Henriksen, Eisenstein group
Title: Quantum Hall effect and semimetallic behavior in ABA trilayer graphene

We present experimental evidence supporting the case that ABA trilayer graphene is a semimetal. Low temperature electronic transport measurements on ABA trilayer graphene flakes have been performed in both zero magnetic field and in fields up to 14 T. At the highest fields the quantum Hall effect is clearly observed, showing a sequence of quantized plateaus in the Hall resistance that is consistent with the band overlap of a semimetal. Meanwhile in the presence of a large perpendicular electric field, additional plateaus arise due to breaking of the mirror symmetry of the trilayer graphene flake. Overall, the evidence points to an unusual system: a semimetal whose band overlap and carrier densities can be controlled by external gates.

Friday, October 28, 2011
Speaker: Tony Lee, Condensed Matter Theory
Title: Collective quantum jumps of Rydberg atoms

A quantum system under constant observation may occasionally switch between two metastable states. These quantum jumps are usually observed in a single object, like an atom, electron, or superconducting qubit. We report on a collective type of quantum jump in a group of atoms with long-range Rydberg interaction, laser driving, and spontaneous emission. Over time, the system occasionally jumps between a state of low Rydberg population and a state of high Rydberg population. The jumps are inherently collective and in fact exist only for a large number of atoms. We explain how entanglement and quantum measurement enable the jumps, which are otherwise classically forbidden.

Friday, November 4, 2011
Speaker: Hanseuk Lee, Vahala group
Title: Ultra-Low-Loss Optical waveguide and resonator on a Silicon Chip

We demonstrate a silica-on-silicon waveguide as long as 27 meters having an optical attenuation rate of 0.08dB/m, 20 times lower loss value than previous works. Over shorter spans, characterized using resonators, an even lower attenuation rate of 0.037dB/m (760 million optical Q) is measured, close to that of optical fiber when first considered a viable technology. These on-chip devices are fabricated based on the standard semiconductor fabrication technology without silica reflow which was essential for previous micro-toroid, thereby expanding the range of integration opportunities and possible applications.

Friday, November 11, 2011
Speaker: Spiros Michalakis, IQI
Title: Stability of Frustration-Free Hamiltonians

I will explain with examples what it means to have a stable spectral gap against arbitrary perturbations of bounded strength. The conditions for stability will be presented with further examples, clarifying the role of topological order in the groundstate subspace. If time permits, an overview of the proof of stability will be given for the general class of frustration-free Hamiltonians.

Friday, November 18, 2011
Speaker: Jeongwan Haah, IQI
Title: Weakly Self-correcting Quantum Memory on Topological Spin Glass

Joint work with Sergey Bravyi (IBM Watson, NY) - We introduce a toy model for self-correcting quantum memory on the three dimensional lattice of spins. A conceptual classical analog is the 2D Ising model for ferromagnet. Our quantum model is inherently glassy without any quenched disorder, and has topologically ordered degenerate ground states. The decoherence of encoded information due to thermal fluctuations is therefore very slow, and the memory time scales as L^{1/T} up to some system size L*, where T is the temperature and L* is proportional to exp(1/T). Hence, for optimally chosen system sizes, the memory time scales as $\exp(1/T^{\wedge 2})$. We numerically verify that our estimation is tight up to constants.

Friday, December 2, 2011
Speaker: Shankar Iyer, CM Theory
Title: A Mott Glass to Superfluid Transition for Random Bosons in Two Dimensions

With David Pekker and Gil Refael - We study the zero temperature superfluid-insulator transition for a two-dimensional model of interacting, lattice bosons in the presence of quenched disorder and particle-hole symmetry. We follow the approach of a recent series of papers by Altman, Kafri, Polkovnikov, and Refael, in which the strong disorder renormalization group is used to study disordered bosons in one dimension. Adapting this method to two dimensions, we study several different species of disorder and uncover universal features of the superfluid-insulator transition. In particular, we locate an unstable finite disorder fixed point that governs the transition between the superfluid and a gapless, glassy insulator. We present numerical evidence that this glassy phase is the incompressible Mott glass and that the transition from this phase to the superfluid is driven by percolation-type process. Finally, we provide estimates of the critical exponents governing this transition.

Friday, December 9, 2011
Speaker: Clement Lacroute, Kimble group
Title: A state-insensitive, compensated nanofiber trap

I will start by describing our scheme for trapping single Cs atoms around an optical nanofiber with reduced light-shifts (arXiv manuscript http://arxiv.org/abs/1110.5372). Following the work of Balykin et al. and Vetsch et al., we propose a robust method of trapping single Cs atoms with a two-color state-insensitive evanescent wave around a dielectric nanofiber. Specifically, we show that vector light shifts induced by the inherent ellipticity of the forward-propagating evanescent wave can be effectively canceled by a backward-propagating evanescent wave. Furthermore, by operating the trapping lasers at the magic wavelengths, we remove the differential scalar light shift between ground and excited states.

I will then present our current effort to integrate this nanofiber trap in a CQED experiment to strongly couple single, optically trapped Cs atoms to a microtoroidal optical resonator.