SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XIX - 6 October 2003 - Tucson, AZ

Session MS: **10:30 AM – 12:00 noon, Joshua Tree Room - John Noé, Stony Brook University, Presider**

MS1 10:30 AM **Unexpected Instabilities in the Dynamic Kingdon Trap,** *Ian Garrick-Bethell, Reinhold Blumel, Wesleyan University, Middletown, CT, USA.*
The dynamic Kingdon trap uses a superposition of static and oscillating electric fields to allow trapping of charged particles. Here we present theoretical work that shows the trap is unstable for certain control parameters that were previously believed to provide stable trapping. These findings are important for operating the trap. Supported by NSF grant PHY-9984075.

MS2 10:45 AM **Interferometric Measurement of Spatial Wigner Functions of Light,** *Bryan J. Killett, Brian J. Smith, and Michael G. Raymer, Oregon Center for Optics, University of Oregon, Eugene, OR, USA.*
A new type of Sagnac interferometer is used to directly measure the spatial Wigner function of light beams. Measured examples include several TEM modes and the classical analog of the Schrödinger Cat state. This setup will be used to characterize decoherence rates and to measure spatial states of single photons. Supported by NSF through REU and ITR.

MS3 11:00 AM **Nonlinear Absorption of Intersubband Transitions in GaAs/Al0.35Ga0.65As Quantum Wells,** *Tina Shih*, Klaus Reimann, Michael Woerner, Thomas Elsaesser, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, 12489 Berlin, Germany (* M. I. T., Cambridge, MA, USA).*
Linear and nonlinear absorption of the intersubband transition in a highly n-doped GaAs/Al0.35Ga0.65As multiple quantum well (MQW) sample was characterized and compared to a previously measured sample with a lower electron density. The observed behavior suggests that radiative coupling is responsible for optical phenomena in high-electron-density MQWs. Supported by NSF through an International REU grant to CREOL.

MS4 11:15 AM **Photothermal Microscopy for Studies of Laser Induced Damage in Optical Components,** *Benjamin C. Richards, Bertrand Bertussi, Jean-Yves Natoli, Mireille Commandre, Institut Fresnel, Ecole Nationale Supérieure de Physique de Marseille, Marseille, France.*
The first visible modifications by high-powered laser pulses of nano-sized gold absorbing defects embedded in silica samples are studied using a high resolution photothermal microscope. The threshold of the first visible modifications are measured for particles of 100 nanometers and 250 nanometers. Supported by NSF through an International REU grant to CREOL.

MS5 11:30 AM **Progress on an Atomic Beam Apparatus for Precision Laser Experiments on Tritium,** *David B. McNeil, David C. Shiner, University of North Texas, Denton, TX, USA.*
One planned experiment is a measurement of the tritium nuclear size using the 1S-2S transition. The apparatus is designed to minimize the amount of this radioactive atom required during measurements. The design allows for storage and reuse of tritium while minimizing contamination. Preliminary tests will be discussed. Supported by NSF

MS6 11:45 AM **Developing Lasers Systems for Trapping and Imaging of Ca^+ Ions,** *Jeremy Ouellette*, Winthrop Smith, Dr. Oleg Makarov, Jian Lin, University of Connecticut, Storrs, CT, USA.(* St. Lawrence University, Canton, NY, USA.)*
A hybrid atom ion / trap including a dual laser system for trapping and imaging has been developed for the study of ultra cold Na / Ca^+ collisions. The physical principles of the trap, along with laser construction will be addressed in the talk. Supported by NSF through an REU supplement to Grant PHY-9988215.

LUNCH BREAK

We are planning to serve a complimentary lunch in the Joshua Tree Room for the participants in this symposium.

This is a wonderful opportunity to make contacts and get to know one another

You may also want to spend some of this time at the OSA poster session.

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Session MEE: 1:30 – 3:30 PM, Joshua Tree Room - Carl Grossman, Swarthmore College, USA, Presider

MEE1 1:30 PM **Deposition and Characterization of ZrO_2 Sol Gel Thin Films,** *Theresa McGovern*, Ludovic Escobas, Ziyad Elalamy, Emmanual Drouard. Institute Fresnel, Marseille, France. (*CREOL, Orlando, FL USA.)*
Sol gel thin films and their thermo-optic properties can be employed in the fabrication of integrated optical components. ZrO_2 sol-gel thin films were deposited by dip coating on various commonly used substrates. The thickness, refractive index and thermo-optic coefficient of the zirconium films were measured using m-lines technique. Supported by NSF through an International REU grant to CREOL.

MEE2 1:45 PM **Improvements in a Laser Interaction Region for Use in Precision Spectroscopy of Helium,** *Nicolas Lopez, Marc Smiciklas, David Shiner, University of North Texas, Denton, TX, USA.*
The interaction region of a 1083nm laser with a helium atomic beam is improved using a feedback controlled retroreflecting mirror. In a addition, a modified Helmholtz geometry is used to obtain a stable and uniform magnetic field. We discuss experimental aspects of these improvements. Supported by NSF and APS Minority Scholarship.

MEE3 2:00 PM **Elaboration and Characterization of Oxysulfide Glasses,** *Bryce W. Campbell*, Glenn Orveillon, Laeticia Petit, Thierry Cardinal, François Guillen, Michel Couzi, Phillipe Vinatier, Institut de Chimie de la Matière Condensée de Bordeaux, France 33608 (* Iowa State University, Ames, IA, USA.)*
Oxysulfide glasses are of particular interest as waveguide materials because of the combination of oxide glass properties (chemical stability) and those of sulfide glasses (improved nonlinear optical properties). Both bulk glass, through remelting sulfinated powder, and thin film, using RF magnetron sputtering, processing routes are examined in this study. Supported by NSF through an International REU grant to CREOL

MEE4 2:15 PM **Theoretical Investigation of Metastable States in Alkaline Earth Atoms,** *Kevin V. Christ, Chris H. Greene, Robin Santra, Department of Physics and JILA, University of Colorado, Boulder, CO, USA.*
We developed a process utilizing finite elements, a model potential, and valence electron correlation that provides calculation of properties of alkaline earth atoms. A number of physical characteristics were calculated for Mg, Ca, and Sr. These quantities are of importance to optical atomic clocks and the physics of ultracold gases.

MEE5 2:30 PM **Long-range Trapping with Optical Tweezers: A Trajectory Analysis,** *Christopher L. DuBois, Perry G. Schiro, and Alfred S. Kwok, Pomona College, Claremont, CA, USA.*
We present the trajectories of 10-micron polystyrene spheres as they are pulled a distance of 30 to 50 microns by laser tweezers into the beam's focus. Analyzing the trajectories allows us to study the forces acting on a sphere as it is pulled into the trap.

MEE6 2:45 PM **Patterned Catalyst for Carbon Nanotubes Using a Novel Maskless Photolithograhy System,** *Brett T. Close, J. David Musgraves, David M. Tannebaum, Pomona College, Claremont, CA, USA.*
Our goal was to grow single-walled carbon nanotubes using a catalyst patterned onto a substrate. We patterned catalyst using a novel maskless projection photolithography system with Novalak photoresist in a liftoff process. We successfully grew tubes from the patterned catalyst in a mix of methane and hydrogen at 1000 C.

MEE7 3:00 PM **Measuring Phase Relations between Coherently and Independently Prepared Bose-Einstein Condensates,** *Mark H. Wheeler, David S. Hall, Amherst College, Amherst, MA, USA.*
We report on progress towards measurements of the relative phase between binary Bose-Einstein condensates that are produced either coherently (via interaction with a resonant field) or independently (via evaporative and sympathetic cooling). These two preparations should lead to markedly different shot-to-shot interference patterns. Supported by NSF and Research Corp.

MEE8 3:15 PM **Observations of the Talbot Effect,** *Allison Schmitz*, John Noé, Harold Metcalf, Stony Brook University, Stony Brook, NY, USA.(* Austin College, Sherman, TX, USA.)*
The Talbot Effect, a self-imaging phenomenon that is related to diverse topics in mathematics and physics, occurs as a natural consequence of Fresnel diffraction when coherent light passes through a periodic grating. We used a CCD camera to record a sequence of diffracted light patterns. These are fractal except at the multiple image positions. Supported by NSF through REU.

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Session MPP: 4:00 PM – 6:00 PM, Joshua Tree Room - - David Hagan, CREOL, Orlando FL, Presider

MPP1 4:00 PM **Photobleaching Dynamics of Organic Dyes Nile Blue and Rhodamine-640 embedded in thin polymer films,** *Jordan Rosen and Carl Grossman, Department of Physics and Astronomy, Swarthmore College, Swarthmore, PA,USA.*
Photobleaching dynamics are presented for laser dyes Nile Blue and Rhodamine-640 embedded in thin polymer films. Time-dependent absorption measurements indicate that the characteristic photobleaching time is not homogeneous but a distribution of inhomogeneous bleaching lifetimes. Comparisons are made with the results of previous measurements of single molecule fluorescence. Supported by Howard Hughes Medical Institute through a grant to Swarthmore College.

MPP2 4:15 PM **Measuring the Kerr Effect in Liquid Helium,** *Eric Williams, A. O. Sushkov, V. V. Yashchuk, and Dmitri Budker, Department of Physics, University of California at Berkeley, Berkeley, CA, USA.*
When an electric field is applied to isotropic medium, it acquires anisotropy leading to a difference in the index of refraction (the Kerr effect). I will discuss this measurement, including the investigation of the temperature dependence of the Kerr constant around the lambda point (normal $\rightarrow$ superfluid) in LHe. Supported by a CLE grant connected with the Neutron EDM experiment at LANL

MPP3 4:30 PM **Frequency Study of a Fiber Grating Stabilized Diode Laser,** *Louis Antonelli, Daniel Mehaffey, Ali Khademian, and David Shiner, University of North Texas, Denton, TX, USA.*
A fiber Bragg grating was attached to a fiber coupled InGaAs laser, resulting in single frequency operation. By studying the beat frequency between two such independently stabilized lasers using a RF spectrum analyzer, laser linewidth measurements were taken. The setup, results, and current status of the experiment will be discussed. Supported by NSF through REU.

MPP4 4:45 PM **A Theoretical Analysis of Multiple Light Scattering in Opaque Glass Ceramics,** *Desirae Leipply*, Martin Letz, Matthias Brinkmann, Thomas Korb, and H. J. Becher, Schott Glas Company, Mainz, Germany. (* Coe College, Cedar Rapids, IA, USA.)*
This project was a theoretical investigation of the effect of structure on the color of opaque glass ceramics. Transmission data were interpreted using the diffusion approximation and a modified diffusing wave spectroscopy technique. Experimental results show the wavelength dependence of the optical mean free path for different ceramization histories. Supported by NSF through an International REU grant to CREOL

MPP5 5:00 PM **Laser Cooling and Bose Einstein Condensation,** *L. Suzanne Leslie* and Gil Summy, Department of Physics, Oklahoma State University, Stillwater, OK, USA. (* Department of Physics, Truman State University, Kirksville, MO, USA.)*
I will present methods for cooling and trapping rubidium atoms with frequency-stabilized diode lasers and a magneto-optical trap. Once the Rb atoms have been trapped, a Bose-Einstein Condensate (BEC) can be achieved by using different techniques to further cool the atoms. I will also describe future experiments that can be performed once a BEC has been achieved. Supported by NSF.