SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XX - 11 October 2004 - Rochester, NY

Session LMB: **10:45 AM – 12:30 noon, Highland J Room - Carl Grossman, Swarthmore College, Presider**

LMB1 10:45 AM **Improving the Output Power of a Littman-Type Diode Laser,** *Brian Neyenhuis, Rebecca Merrill, Scott Bergeson and Dallin S. Durfee, Brigham Young University, Provo, UT, USA.*
We will present a method to increase the output power of a Littman-type diode laser using an intracavity Faraday isolator. We will also present a mathematical model to explain the laser's tuning properties and our latest experimental results to verify this theory. Supported by NSF through REU and Brigham Young University.

LMB2 11:00 AM **Creating a Rotating Optical Potential for a BEC,** *Melissa E. Friedman*, Peter Engels, Volker Schweikhard, Shih-Kuang Tung, University of Colorado, Boulder CO, USA, Eric Cornell, University of Colorado and NIST (*Stony Brook University, Stony Brook, NY 11794-3800 USA.*
A rotating BEC forms a vortex lattice. We can induce lattice modes by applying a rotating optical lattice formed by multiple beam interference. Superfluid vortices, principles of interference, light-matter interaction, and lattice construction will be discussed. Supported by NIST and by NSF through REU.

LMB3 11:15 AM **Femtosecond Infrared Spectroscopy on Condensed Phase Hydrogen Bonding,** *Curtis Rosenow*, Karsten Heyne, Erik Niberring, Thomas Elsaesser, Max-Born-Institute, Berlin, Germany. (* U. Arizona)*
Pump-probe femtosecond spectroscopy in the mid-infrared region is used to study relaxations in molecular vibrations. This technique shows redistribution of O-H stretching vibrations on sub-picosecond timescales for medium strength intramolecular hydrogen bonds in the condensed phase. Supported by NSF through REU.

LMB4 11:30 AM **Spatial Filtering in Optical Image Processing,** *Lidiya Mishchenko, John Noé, Harold Metcalf, Laser Teaching Center, Stony Brook University, Stony Brook, NY 11794-3800 USA.*
A *4f* spatial filtering system was used to do high-pass, low-pass, and orientation filtering. This setup demonstrated how different spatial frequencies contribute to image formation. High-pass filtering can do image enhancement, low pass filtering can remove grain noise, and orientation filtering can affect patterns. Supported by NSF through REU.

LMB5 11:45 AM **Theoretical Development of Siegert Pseudostates as a Method for Treating Scattering Phenomena,** *Robin Santra, Jeffrey Shainline, and Chris Greene, University of Colorado and JILA, Boulder, CO, USA.*
Attention is paid to issues of completeness within the formalism of Siegert pseudostates, as well as to the evolution of wave packets in time, expanded in the basis of Siegert pseudostates. Supported by the Department of Energy.

LMB6 12:00 PM **Creating Light with a Twist**, *Azure Hansen, John Noé, Harold Metcalf, Laser Teaching Center, Stony Brook University, Stony Brook, NY 11794-3800 USA*
Optical vortices are laser beams with a helical phase front that creates a central dark singularity. These have interesting characteristics and applications. We studied and measured properties of such vortices created with a computer generated "fork" diffraction grating, including intensity profiles and interference patterns. Supported by NSF - REU.

LMB7 12:15 PM **Low Temperature Absorption and Emission Spectroscopy of Ytterbium-Doped Laser Materials,** *John Murray, Inka Manek-Hönninger, Centre Lasers Intenses et Applications, Univ. Bordeaux I, Talence, France, Thierry Cardinal Institut de Chimie de la Matière Condensée, Université Bordeaux 1, Pessac, France*
We have begun a low temperature spectroscopic study of several ytterbium-doped laser materials that can generate ultra-short pulses (Yb:YAG, Yb:KYW, and Yb:glass). Absorption measurements suggest that cooling these materials to low temperature might improve their thermal and spectroscopic properties. Supported by NSF through REU.

LUNCH BREAK AND POSTER SESSION

We will serve a complimentary lunch in the Highland J Room for the symposium participants.

Session UGPS (poster): 12:30 - 2:00 PM, Highland Corridor - John Noé, Stony Brook, Presider

UGPS1 12:30 PM **Effect of Light-Induced Atomic Desorption on Relaxation of Atomic Polarization in Paraffin-Coated Cells**, *Miriam T. Graf, D. F. Kimball, S. M. Rochester, D. Budker, Univ. of California, Berkeley, CA.*
Time-dependent optical rotation of linearly polarized light is measured to determine the relaxation rates of ground-state atomic polarization in paraffin-coated cesium vapor cells during light-induced atomic desorption (LIAD). Supported by NSF and ONR.

UGPS2 12:30 PM **Atomic Excitation by Frequency-Chirped Laser Light,** *Jessica Thrower*, M.J. Wright and Phil L. Gould, University of Connecticut, Storrs, CT, USA - *Stanford University, Stanford, CA.*
Chirping the light of a laser, or changing its frequency with time, is an effective method of transferring a population of atoms to the excited state. We study how excitation probability depends on the various laser parameters. Supported by NSF through REU.

UGPS3 12:30 PM **Optical Frequency Comb for Precise Frequency Measurements at Many Wavelengths,** *Gregory Ogin, Heather Partner, Dana Berkeland, Malcolm Boshier,Los Alamos Nat'l Lab., Los Alamos, NM 87545.*
We have built an optical frequency comb using a mode-locked Ti:S laser and a non-linear photonic-crystal fiber. This instrument will measure the frequencies and instabilities of lasers of several different wavelengths. I will discuss the optics of this system and the feedback electronics used to lock comb frequencies.

UGPS4 12:30 PM **Stabilizing the Frequency of a 980 nm Diode Laser**, *Maria Bellon, Ali Khademian, and David Shiner, University of North Texas, Denton, TX, USA.*
We wish to utilize a 980 nm laser module as a convenient, reliable, and low cost laser source for experiments in atomic physics. We have designed a fiber optic external cavity laser which uses feedback techniques and incorporates a fiber Bragg grating and a piezoelectric tuning element. Supported by NSF through REU.

UGPS5 12:30 PM **Propagation of Quantized Evanescent Wave Fields,** *Meral Rehyan, Rensselaer Polytechnic Institute (R.P.I.) Troy, NY, Martin Ligare, Bucknell University, Lewisburg, PA, USA.*
We present numerical studies illustrating the time-dependent propagation of photons in simple models that include evanescent waves. We show how the evanescent waves accompanying total internal reflection affect the properties of reflected photons. Supported by NSF through REU.

UGPS6 12:30 PM **Optical Characterization of Germanium Oxysulfide Thin Films from their Transmission Spectra,** *N. Carlie*, B. Campbell, G. Orveillon, L. Petit*, K. Richardson*, T. Cardinal, M. Couzi, F. Guillen, P. Vinatier, University of Bordeaux I, Bordeaux, France. *CREOL Univ. of Central Florida, Orlando, FL 32816 USA.*
Germanium oxysulfide thin films have been characterized using UV-VIS transmission spectroscopy. Surface oxide passivation has been evidenced. Photo-darkening by bandgap irradiation has been demonstrated, which makes these materials promising for photonics applications. Supported by NSF through REU.

UGPS7 12:30 PM **Atomic Relaxations of Optically Pumped Potassium in Anti-Relaxation Cells,** *Jennie Guzman, Jason E. Stalnaker, Valeriy V. Yashchuk , Dmitry Budker, University of California, Berkeley, CA, USA.*
Miniature atomic clocks and magnetometers may be possible using alkali atoms contained in small (<1 cm^3) anti-relaxation-coated glass cells. We are investigating spin-relaxation mechanisms by comparing Zeeman and ground-state hyperfine relaxation rates in potassium. Supported by NSF through REU.

UGPS8 12:30 PM **Ultra-Cold Atom Research at Swarthmore College**, *Alexander Atanasiu, Frank Moscatelli, Swarthmore College, Swarthmore, PA 19081 USA.*
Our experiment centers on controlling ultra-cold Rb atoms on the surface of optical waveguides. A series of SiON waveguides on silicon wafers are being produced for this purpose, while the dynamics of our Magneto Optic Trap are presently being studied. These preliminary results will be presented along with future plans.

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

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Session LME: 2:00 – 3:45 PM, Highland J Room - Enriqué Galvez, Colgate University, Presider

LME1 2:00 PM **Spectroscopic Characterization of Two Structurally Different Yb^{3+}-Doped Thin-Film Materials, Fabricated from GGG using PLD**. *Janelle Shane*, Jan Lancok, Claudine Garapon, and Stéphan. Guy, Laboratoire de Phyisco-Chimie des Matériaux Luminescents, Université Lyon I, UMR-CNRS, France (*Michigan State University, East Lansing, MI 48825 USA)*
We used Pulsed Laser Deposition (PLD) to create structurally different Yb^{3+}-doped thin films from the same base material ($Gd_3Ga_5O_{12}$). By choosing the substrate structure, we fabricated gadolinium gallium perovskite, which is unstable in bulk form. Spectroscopic properties are discussed. Supported by NSF (REU) and a Curie Fellowship.

LME2 2:15 PM **Development of a Magneto-Optical Trap in an Undergraduate Laboratory**, *Rita Kalra, James Scholtz, John Noé, Harold Metcalf, Laser Teaching Center, Stony Brook University, Stony Brook, 11794-3800 USA*
A magneto-optical trap for rubidium atoms is under construction. Saturated absorption spectroscopy of Rb using an external-cavity 780 nm diode laser has been achieved thus far. Progress in frequency stabilization of the laser as well as future plans will be discussed. Supported by NSF through REU.

LME3 2:30 PM **Remote Control of the Visibility of Single-Photon Interference Using Maximally Entangled Photon Pairs,** *Matthew Pysher, Enriqué Galvez, Kartik Misra, Colgate University, Hamilton, NY 13346 USA*
We send one photon from an entangled pair through an interferometer. The interferometer is arranged so the degree of single-photon interference observed is controlled by a polarizer placed in the path of the photon not traveling through the interferometer. Supported by Research Corporation and NSF Grant PHY-9988004

LME4 2:45 PM **Modeling of a VCSEL with an Integrated Quantum Well Absorber,** *Preema Pais, Muluwork Geremew, Dietrich Lüerssen, Mark Peterson, and Janice Hudgings, Mount Holyoke College, South Hadley, MA.*
We develop a rate equation model for a vertical-cavity surface-emitting laser (VCSEL) with an integrated quantum well absorber. It can serve as an integrated modulator with a 3dB bandwidth of 4.5GHz/mA. The model explores the physical origins of the absorber's I-V characteristics, including negative differential resistance. Supported by NSF.

LME5 3:00 PM **An Experimental Study of a Vertical-Cavity Surface-Emitting Laser (VCSEL) with Optical Feedback**, *B. Viechnicki, G. Marsh, H. Lin, Bates College, Lewiston, Maine 04240 USA.*
The transverse dynamics of a VCSEL with optical feedback is experimentally studied. Without feedback our VCSEL operates multi-mode with orthogonal polarizations. With optical feedback there is single-mode operation near threshold. At higher currents, optical feedback induces linearly polarized output from the VCSEL.

LME6 3:15 PM **Experimental Investigation of a Microwave Discharge Source for Producing Metastable Argon,** *Matthew Weinberg, Rodney C. Beckner, Charles I. Sukenik, George Brooke, and Svetozar Popovoc, Old Dominion University, Norfolk, VA 23529 USA.*
We will report progress in characterizing the production of Ar* atoms using a microwave discharge source constructed in part from a commercial microwave oven. Comparison to other metastable sources such as rf and dc discharges will be made. Metastable argon atoms will be used for experiments in trapping and cooling. Supported by the NSF through REU.

LME7 3:30 PM **Observing a Feshbach Resonance in an Optically Trapped Rubidium-87 BEC,** *Tarun Menon, Margaret A. McKeon, Kevin M. Mertes, David S. Hall, Amherst College, Amherst, MA 01002-5000 USA.*
We report progress towards a double Bose-Einstein condensate (BEC) with tunable interspecies interactions using a Feshbach resonance between condensates in $|F = 1, m_F = +1\rangle$ and $|F = 2, m_F = -1\rangle$ hyperfine states simultaneously confined in an elliptical beam optical trap. Preliminary results show increased inelastic losses near B = 9.108 Gauss.