SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXVIII - 17 October 2022 - Rochester, NY

PARTICIPANTS' LUNCHEON – Lilac Ballroom - 12:00

Sandwich lunches will be provided for participants and invited guests only.

POSTER SESSION – Lilac Ballroom - 1:00 - 3:00

Session SM3G (poster) 1:00 - 3:00 PM, Lilac Ballroom

Nicholas Bigelow, University of Rochester, Presider

SM3G – 1 Generating the polarization-entangled photon state with the highest fidelity, *Xiangqin Wang, Nikoloz Bujiashvili, Valeria Rodríguez-Fajardo, and Enrique Galvez, Colgate University, Hamilton, NY 13346.* We adopted ID900, a high-frequency time-tagging equipment, as a more rigorous way of detecting the entangled photon pairs. Combined with automated components, we prepared the photons in an entangled state of high fidelity. The new setup consistently produced states with tomography results and Bell numbers close to the theoretical values. Supported by NSF.

SM3G – 2 Polarization-Independent Fast Active Optical Switching via the Pockels Effect, *Brian Petro, Oliver Johnson, Leo Oshiro, John Floyd, Ujaan Purakayastha, and Paul Kwiat, University of Illinois Urbana-Champaign, IL 61801.* Fast polarization-independent routing is critical for photonic quantum networking. We demonstrate a 1x2 active-switch operating at a frequency of ~100kHz with minimal degradation to the polarization state of the input photons. We obtained high gate fidelities of 98.3% (95.8%) and extinction ratios of 120.6 (45.5) in the transmitted (reflected) ports. Supported by NASA and the DOE.

SM3G – 3 Directed propagation of cold atoms – mechanical resonance or velocity matching? *Krishna Pandey, Casey Scoggins, Daniel Wingert, Jordan Churi, and Samir Bali, Miami University, Oxford, OH 45056.* Atoms confined in an optical lattice oscillate inside potential wells, occasionally hopping to adjacent wells, thereby diffusing in all directions. By weakly modulating the lattice we observe directed propagation. We investigate whether this propagation originates from a mechanical resonance between the modulation and oscillation frequencies, or a subtle velocity matching condition. Supported by the US Army Research Office.

SM3G – 4 Measurement of the lifetime of excited states in the Lanthanum anion, *Fabrizio E. Vassallo, N. Daniel Gibson, and C. Wesley Walter, Denison University, Granville, OH 43023*. We measured the lifetime of three excited states of La^- at the DESIREE facility in Stockholm, Sweden, finding concrete values to verify and challenge previous theoretical predictions. This experiment provides a timely check on this element's aptness as a candidate to be the first ever anion used for laser cooling. Supported by the NSF and Denison University.

SM3G – 5 Quantum Material Detection via Deep Learning and Large-scale Thickness Data Collection, *Apoorva Bisht[1,2], Xuan Bac Nguyen[1], Jordan Simpson[1], Hugh Churchill[2] and Khoa Luu[1], 1) Computer Science and Engineering Department, University of Arkansas, Fayetteville, AR 72701, 2) Physics Department, Univ. of Arkansas, Fayetteville, AR 72701.* We develop a model to determine thickness of 2D material flakes like hexagonal boron nitride by exploiting the property of thickness-dependent color variation. A dataset establishing the color-to-thickness correspondence allows us to bypass physical methods like AFM to determine the thickness and makes thickness estimation process efficient. Supported by Honors College Research Grant and MonArk Quantum Foundry.

SM3G – 6 Joint numerical and experimental investigation of geometry dependent frequency shifts in superconducting microwave resonators, *Theodore Gifford, Jeffrey Wack, Maya Amouzegar, Martin Ritter, and Alicia Kollár, University of Maryland, MD 20742.* We investigate geometry-dependent frequency shifts in superconducting microwave resonators for quantum simulations of lattice and spin models using superconducting qubits. Numerical simulations of geometry-dependent effects in Ansys High-Frequency Simulation Software (HFSS) are corroborated with measurements of real superconducting devices. Supported by the National Science Foundation (QLCI grant OMA-2120757).

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Session SM3G (poster) 1:00 - 3:00 PM, Lilac Ballroom

Nicholas Bigelow, University of Rochester, Presider

SM3G – 7 Digital laser locking of a two-photon frequency standard, *Samuel Carlson and Nathan Lemke, Bethel University, MN 55112.* The Doppler-free two-photon transitions in Rubidium are used to develop robust optical frequency standards. A high-speed DAQ system was designed and implemented to demodulate and lock two lasers to transitions in Rb-85 and Rb-87. Anticipated applications of high-precision frequency standards range from optical communications to global navigation technologies. Supported by the NASA Minnesota Space Grant.

SM3G – 8 Investigation of Dicke narrowing in warm alkali vapor for different buffer gas pressures, *Macbeth Julius, Scott Wenner, Reese Tyra, and Samir Bali, Miami University, Oxford, OH 45056.* We observe a dramatic reduction in width, or Dicke narrowing, of Doppler-broadened absorption lines in alkali atoms, due to frequent velocity-changing collisions with buffer gas atoms. These collisions tightly spatially confine each alkali atom. We measure the Dicke narrowing for different buffer gas pressures, and obtain good agreement with theory. Funded by the US Army Research Office.

SM3G – 9 Coupling Efficiency of Laguerre-Gaussian Modes in a Hollow Fiber, *Cameron Brady [1,2], Eric Jones [1], and Harold Metcalf [1], 1) Stony Brook University, Stony Brook NY 11794, 2) Rowan University, Glassboro NJ 08028.* Laguerre-Gaussian modes can be used for optical tweezers and optical communication. We have demonstrated the transfer of such beams in a hollow fiber. This is shown through spiral interference patterns before and after the fiber proving the Laguerre-Gaussian mode is maintained. Supported by NSF Grant # 1852143.

SM3G – 10 Observing Self-Healing Effects of Gravitational Lensing in a Laboratory Setting, *Kiyan Hocek, Valeria Rodríguez-Fajardo, and Enrique Galvez, Colgate University, Hamilton, NY 13346.* We simulated gravitational lensing using a spatial light modulator. We created Bessel-like Einstein beams and observed Einstein rings and arcs. We investigated placing an obstruction over part of the beam and finding the distance at which the beam pattern reformed itself. Supported by NSF.

SM3G – 11 Dependence of single-slit diffraction of LG beams on mode indices, *Alexandra Lee [1,2], Reeta Vyas [2], and Surendra Singh [2], 1) University of North Carolina Asheville, NC 28804, 2) University of Arkansas, Fayetteville, AR 72701.* We studied single-slit Fraunhofer diffraction of Laguerre-Gauss (LG) beams as a function of mode indices and slit position relative to the beam waist. A quantitative relation between diffraction features and mode indices, useful for characterizing unknown LG beams, was identified. The experimental results agree with the theoretical predictions. Supported by NSF Grant # 1851919.

SM3G – 12 Developing an algorithm for arc length-weighted anti-aliasing propagation of beams with 1D Fourier spectra, *Kyle Cash, Matthew Gootman, Zahin Ritee, and Kevin Liang, Adelphi University, Garden City, NY 11530.* Using an arc length-weighted anti-aliasing algorithm in MATLAB, we allow for the numerical generation of optical beams with one-dimensional Fourier spectra that minimizes the error induced by discretization. This generation results in a representation that optimally exhibits the properties and behaviors of such beams, which include anti-diffraction and self-healing. Supported by the Horace G. McDonell Summer Research Fellowship.

SM3G – 13 Angular momentum measurements through polarimetry, *Danae Evans, Elaina Wahmann, and Catherine Herne, SUNY New Paltz, New Paltz, NY 12561.* The changes of light's angular momentum as it passes through birefringent materials is the principle behind much of the spinning of objects in optical tweezers. We measure the change in angular momentum through simple objects using polarimetry, and then apply polarimetry to calcite rhombohedrons to determine the angular momentum transfer through complex objects.

SM3G – 14 Single-shot polarimeter with a Raspberry Pi system, *Johnny George [1], Clark Kwun [2], Ezra Naik [2], Bailey Brown [3], Muhammed Khan [3], and Edward C. Samson [2], 1) Youngstown State University, Youngstown, OH 44555, 2) Miami University, Oxford, OH 45056, 3) Talawanda High School, Oxford, OH 45056.* We develop a system for measuring the polarization state of a Gaussian laser beam. By constructing and implementing a Savart plate imaging polarimeter with a Raspberry Pi camera system, we can calculate the Stokes parameters from a single image. Funded by the NSF and the US Army Research Office.

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Nicholas Bigelow, University of Rochester, Presider

SM3G – 15 Rotating optical beams for free-space communications, *Tarik Cigeroglu, Valeria Rodríguez-Fajardo, and Enrique Galvez, Colgate University, Hamilton, NY 13346.* We constructed Poincaré beams with rotating polarization patterns by changing the relative phase between polarization/mode components. We encoded information in the rotation speed of the light patterns. Supported by the NSF.

SM3G – 16 Calcite Orientation in Response to Linearly Polarized Light, *Elaina Wahmann, Danae Evans, and Catherine Herne, SUNY New Paltz, New Paltz, NY 12561.* Using light to control small objects is integral to tiny optomechanics. We produce optically responsive calcite rhombohedrons and trap them in linearly polarized light. We demonstrate and model the orientation of the crystals relative to the beam propagation direction and the polarization direction.

SM3G – 17 Digital holography for imaging deflections and twists, *Gabe Hjelle, Nathan Lemke, and Nathan Lindquist, Bethel University, St. Paul, MN 55112.* We developed a digital holography apparatus to image different materials under bending loads and torques. Direct imaging of the deformation allows for a model of the stress/strain relationship to be developed. This apparatus will be used in undergraduate laboratory experiments. Supported by NSF.

SM3G – 18 Construction of an Optical Microscope with Video Projector Illumination, *Neha Sunil and Edward Carlo Samson, Miami University, OH 45056.* We developed a microscope that can achieve various contrast-enhancement methods utilizing structured illumination from a quick and affordable source, a video projector. We analyzed the performance of our system by measuring its optical resolution and modulation transfer function. We will show comparisons of images taken under different methods of illumination.

SM3G – 19 Using a Spatial Filter to Reduce Noise in Optical Diffraction, *Katie Canavan, Raffaella Zanetti, Asia Baker, and Jenny Magnes, Vassar College, NY, 12604.* We analyze the locomotion of *C. elegans* through laser diffraction. We use a spatial filter and an assortment of lenses to ensure the laser beam intensity is uniform. As a result, we eliminated unintended noise in the dynamic diffraction pattern of a live nematode.

SM3G – 20 MATLAB data analysis of high-speed spectral fluctuations, *Trey Adelsman, Nathan Lemke, and Nathan Lindquist, Bethel University, MN 55112.* We programmed an anomaly detection algorithm in a user-friendly MATLAB application in order to detect high-speed fluctuation events from single-molecule surface-enhanced Raman spectroscopy (SERS). The application automatically extracts various features from each event and classifies them according to their spectral content. Supported by NSF.

SM3G – 21 Near atomic scale diffraction imaging, *Nash Karrington[1], Joshua Miller[1], Landon Schnebley[1], J. Nicholas Porter[1], Jason Meziere[1], Wonsuk Cha[2], Ross J. Harder[2], Richard L. Sandberg[1], 1) Brigham Young University, Provo, UT 84653, 2) Advanced Photon Source, Argonne National Laboratory, Lemont, IL 60439.* Bragg Coherent Diffraction Imaging (BCDI) is an x-ray strain imaging technique with spatial resolution of a few nanometers. We are developing an advancement to BCDI to push the resolution to the near atomic scale. We will discuss our efforts to make and characterize samples appropriate for these techniques. Supported by DOE-BES DE-SC0022133 and BYU College of Science.

SM3G – 22 LabVIEW laser control system for high-speed spectroscopy, *Trevin Schmidt, Caleb Christiansen, Nathan Lemke, and Nathan Lindquist, Bethel University, MN 55112.* We developed a LabVIEW interface for simultaneous control of three lasers using three Acousto-Optic Modulators and an FPGA module. This will be used to observe how different laser wavelengths affect the high-speed signals coming from a single-molecule surface-enhanced Raman spectroscopy experiment. Supported by NSF.

SM3G – 23 Unfolding *C. elegans* Locomotion Time Series to Demonstrate Chaos, *Raffaella Zanetti, Katie Canavan, and Jenny Magnes, Vassar College, NY, 12604.* The locomotion of *C. elegans* is studied using dynamic diffraction patterns. We compared the intensity fluctuations at various points in the diffraction pattern using chaotic markers. The largest Lyapunov exponent is 1.1 ± 0.2 1/s, indicating chaos. Time series are compared with those of neuronal models.

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SM3G – 24 Pulse Creation Using an Amplitude Modulator, *Otto Nicholson [1], Jianneng Yu [2], Edoardo Buonocore [2], and Harold Metcalf [2], 1) Williams College, Williamstown, MA 01267; 2) Stony Brook University, Stony Brook, NY 11794.* We used an amplitude modulator on a 1083 nm beam to create a pulse to study the Adiabatic Rapid Passage (ARP) force. Using a PZT on a Fabry-Pèrot, we were able to scan and study the characteristics of the pulse, and found that there are side-band frequencies present to make the pulse. Funded by the NSF grant - PHY-1852143.

SM3G – 25 Building a compact portable Infrared Viewer for less than $250 using a Raspberry Pi, *Chanakya Pandya [1], Reese Tyra [1], Bailey Brown [2], Muhammed Khan [2], and Samir Bali [1], 1) Miami University, Oxford, OH 45056, 2) Talawanda High School, Oxford, OH 45056.* Using readily available, inexpensive hobbyist components, we have built a handheld portable infrared viewer costing 10X less than its commercial counterpart. A Raspberry Pi single-board computer is used along with touchscreen and camera components. Our product offers larger display size than the commercial unit, a rugged structure, and easier DIY repair. Funded by the US Army Research Office.

SM3G – 26 Improving an In-vacuum Monochromator for a Broadband Extreme Ultraviolet Light Source, *Alejandro Morales Gutierrez [1], Aaron Redd [2], Taylor Buckway [2], Richard L. Sandberg [2], 1) Brigham Young University, Idaho, Rexburg, ID 83460, 2) Brigham Young University, Provo, UT 84602.* This work focuses on designing and creating a motorized turntable for an in-vacuum coherent diffraction imaging setup using high harmonic generation. The goal is rapid switching between a normal incidence mirror setup and a spectroscopy setup. These configurations are used to image nanostructures using extreme ultraviolet light. Supported by NSF grant # 2051129 and the WAESO grant.

SM3G – 27 Characterization of organic field-effect transistors using modulated amplitude reflectance spectroscopy, *Haakon Pihlaja, Taylor Venenciano, Yannai Kashtan, Ricardo Espinoza, Ana Sofia de Olazarra, David Tanenbaum, Gordon Stecklein, and Janice Hudgings, Pomona College, Claremont, CA 91711.* We generate high-resolution, spatially-mapped images of organic field-effect transistors to study device properties such as charge carrier concentration and mobility. After fabricating transistors from the semiconducting polymer poly(3-hexylthiophene), we use a CCD camera and processing algorithm to measure carrier-induced local changes in surface reflectivity that occur during device operation. Supported by NSF award #1919282.

SM3G – 28 Design and Improvement of a Tunable Water Cell for Short Laser Pulse Measurements and Dispersion Control, *Hope Dannar, Eric Jones, and Thomas Weinacht, Stony Brook University, Stony Brook, NY, 11794.* A variable path length water cell produced severe distortions in the laser beam propagating through it. To correct the distortions, the components of the cell were tested. Once the problem was diagnosed, replacement and careful adjustment of the windows resolved the problem and resulted in distortion-free propagation through the cell. This research was supported by the National Science Foundation under Grant No. NSF PHY-1852143.

SM3G – 29 Development of Robust Gold Nanoparticle Samples for Bragg Coherent Diffraction Imaging, *Landon Schnebly [1], Richard Sandberg [1], Nick Porter [1], Naomi Jensen [1], Yueheng Zhang [2], Matt Wilkin [2], Anthony Rollett [2], Ross Harder [3], Wonsuk Cha [3], Barbara Frosik [3], 1) Brigham Young University, Provo, UT 84604, 2) Carnegie Mellon University, Pittsburgh, PA 15213, 3) Argonne National Laboratory, Lemont, IL, 60439.* We seek to characterize strain in polycrystalline metals using Bragg Coherent Diffraction Imaging. We utilize a high-energy x-ray beam to gather the data and have had problems with gold nanoparticles rotating due to radiation pressure. We have developed a robust sample recipe using information from SEM analysis of past samples.

SM3G – 30 Passive Reduction of Acoustic-Regime Phase Noise in Optical Fiber, *Jason Lau [1,2], Andrew Malm [2], Bruce Tiemann [2], Matthew Bohn [2], Raanan Tobey [2], Lora Nugent [2], 1) University of Rochester, Rochester, NY 14627, 2) Quantinuum, Broomfield, CO 80021.* Phase noise limits the performance of many laser-based high-precision technologies. We validate "best practice" techniques to reduce fiber-induced phase noise such as path-length matching and acousto-mechanical shielding on the fiber arms of a Mach-Zehnder heterodyne interferometer. We also explore the effects of differential fiber lengths on phase noise.

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Session SM3G (poster) 1:00 - 3:00 PM, Lilac Ballroom

Nicholas Bigelow, University of Rochester, Presider

SM3G – 31 Investigation of the spectral sensitivity of the SERS hotspot using a tunable laser, *Essa St. George, Nathan Lemke, and Nathan Lindquist, Bethel University, St. Paul, MN 55112.* We created a tunable diode laser for use in an existing Surface-Enhanced Raman Spectroscopy (SERS) system. In order to determine the effect of small wavelength changes on SERS intensity fluctuations, this laser was tuned close to the wavelength of a fixed laser. SERS data was collected using the two lasers simultaneously. Supported by NSF.

SM3G – 32 Effect of Optical Feedback on a High-Power Vertical-Cavity Surface-Emitting Laser, *Milly Detels, Clay Hundertmark, and Hong Lin, Bates College, Lewiston, ME 04240*. We experimentally studied an unpolarized vertical-cavity surface-emitting laser with a multi-mode output from the threshold current. It was found that optical feedback can suppress higher-order modes and result in single mode operation. Furthermore, the output of the laser can become polarized when optical feedback is applied. Supported by Bates College.

SM3G – 33 Multiphoton Detection of Long Wavelength Laser Pulses, *Logan Tonini, Autumn Zhong, Michael E. Durst, Middlebury College, Middlebury, VT 05753.* We optimize the multiphoton detection of long-wavelength laser pulses with the goal of exciting near infrared fluorescent dyes. Two-photon excitation builds 3D images of thick tissue one depth at a time. We characterize different photodiodes capable of a two-photon response for excitation between 800 nm and 1800 nm. Supported by the NIBIB of the NIH (R15EB025585).

SM3G – 34 Carbon-Based Mesoscopic Screen-Printed Perovskite Solar Cells: Fabrication and Characterization *Kylie Thompson, Dan Tan, David Tanenbaum, Pomona College, Claremont, CA 91711.* We fabricate carbon-based lead halide perovskite solar cells and characterize the cells over time to investigate degradation pathways. We spatially map both the structure and photovoltaic performance of our cells to track and classify defects. Cell performance is measured by IV curves and quantum efficiency measurements. This work was supported by the Sontag Endowment for Physics and NSF Number Award 1919282.

SM3G – 35 Comparison between x-ray free electron laser (XFEL) phase contrast imaging and hydrodynamical simulations of void collapse in PETN single crystals, *Christian McCombs [1], Daniel S. Hodge [1], Cynthia Bolme [2], Arianna Gleason [3], K. Ramos [2], Q. McCulloch [2], S. McGrane [2], K. Brown [2], M. Greenfield [2], T. Pierce [2], M. Cawkwell [2], DJ Luscher [2], F. Seiboth [4], A. Schropp [4], B. Nagler [3], E. Galtier [3], P. Heimann [3], H.J. Lee [3], Richard L. Sandberg [1,2], 1) Brigham Young University, Provo, UT 84653, 2) Los Alamos National Laboratory, Los Alamos, NM 87545, 3) SLAC National Accelerator Laboratory, Menlo Park, CA 94025, 4) DESY and University of Hamburg, 20148 Hamburg, Germany.* We perform the comparison of hydrodynamic simulations of shocked, single-crystal Pentaerythritol tetranitrate with laser milled 10 micron voids to Single-shot X-ray Free Electron Laser Phase-contrast detector images. The results of this experiment represent the highest resolution imaging of shocked high explosives and will improve our understanding of hot spot formation in high explosives.

Group Photo Break 3:00 – 3:15 pm --- PLEASE assemble at the designated place!!!

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Session SM4G (oral session) 3:15 - 4:30 PM, Lilac Ballroom

Samir Bali, Miami University, Presider

SM4G – 1 Polarization Drift Compensation for Long-Distance Quantum Communication in Optical Fibers, *Deven Bowman, Patrick Banner, Steven Rolston, Trey Porto, Deniz Kurdak, Yaxin Li, University of Maryland, MD 20740.* A system to actively compensate for polarization drift in optical fibers for polarization-encoded quantum networking has been developed. We will present preliminary results, including the results of building and calibrating a 6-detector Stokes polarimeter, and polarization measurements in a 26-km installed fiber link. This work was supported by the U.S. Army Research Laboratory and NSF Grant No. DGE 1840340.

SM4G – 2 Effect of a qubit on the probe light transmission in spinning optomechanical ring resonators, *Jessica Burns [1], Owen Root [2], and Imran Mirza [3], 1) University of Cincinnati, Cincinnati, OH 45221, 2) Nebraska Wesleyan University, Lincoln, NE 68504, 3) Miami University, Oxford, OH 45056.* We study the probe transmission in a spinning optomechanical ring resonator coupled with a single qubit. We find that the presence of a strongly coupled qubit enhances the transmission rate when the ring spins clockwise but not when it spins counter-clockwise, which can find applications in quantum computing and communication. Supported by the NSF, grant 1757575.

SM4G – 3 Hard-X-ray, optical Transient Grating for probing ultrafast dynamics in solids, *Jacob Feltman [1,2], William Peters [1], Travis Jones [1,4], Sanghoon Song [3], Matthieu Chollet [3], Joseph Robinson [3], Prashant Padmanabhan [1], Laura Foglia [2], Richard L. Sandberg [5], Filippo Bencivenga [5], Ryan Coffee [3,6], and Pamela Bowlan [1] , 1) Los Alamos National Laboratory, Los Alamos, NM 87545, 2) Brigham Young University, Provo, UT 84653, 3) SLAC National Accelerator Laboratory, Menlo Park, CA 94025, 4) Georgia Institute of Technology, Atlanta, GA 30332, 5) Elettra-Sincrotrone, 34149 Basovizza, Trieste, Italy 6) Stanford Pulse Institute, Stanford, CA 94305.* Femtosecond X-rays give access to the fundamental spatial and temporal scales of matter. However, many optical methods of probing ultrafast dynamics have yet to be implemented in the x-ray range. We discuss a transient grating experiment using femtosecond x-ray pulses applied in the solids BGO, YAG, and ZnO for probing phonon dynamics. This work was funded by LDRD and DOE SULI.

SM4G – 4 Optical State Detection in Trapped Ion Quantum Computing, *Paul Slayback [1,2], Jay Esposito [2], Azure Hansen [2], Alex Hall [2], Conrad Roman [2], Juan Pino [2] 1) Colorado School of Mines, Golden CO 80401 2) Quantinuum, Broomfield CO 80021.* Foundational to trapped ion quantum computing is the usage of lasers to control the states of ions and enact quantum gates. Additionally lasers can induce state dependent fluorescence, allowing for state detection and other information to be extracted. Here we discuss the precision optimization and alignment of these beams.

SM4G – 5 Quality factor saturation in mass-loaded tensioned mechanical resonators, *Sanjay Kumar Keshava, Ravid Shaniv, Christopher Reetz, Cindy Regal, University of Colorado Boulder and JILA, CO 80309.* Numerous precision sensing applications employ functionalized mechanical resonators. Functionalization adds mass to the resonator which affects its quality factor, and hence its sensitivity. We study the behavior of mass-loaded tensioned resonators both theoretically and experimentally, and demonstrate a surprising quality factor saturation effect. This work was supported by Research Corporation, NSF, and UROP.

SM4G – 6 Light-Induced Atomic Desorption (LIAD) in Alkali Vapor Cells, *Will Pajak, Nathan Nunley, Paul Kunz, University of Texas at Austin, TX 78712.* We assess the utility of non-resonant light for rapidly controlling vapor density in borosilicate glass cells of different dimensions and inner coatings, and discuss competing theories that disagree about the relevant surface diffusion processes involved.

4:30 – 4:45 pm --- Break

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XXXVIII - 17 October 2022 - Rochester, NY

Session SM4G (oral session) 4:45 - 6:00 PM, Lilac Ballroom

Harold Metcalf, Stony Brook University, Presider

SM4G – 7 Sideband cooling of a trapped ion using sunlight, *Amanda Younes, Wesley Campbell, University of California, Los Angeles, Los Angeles, CA 90095.* We intend to use sunlight at 614nm to sideband cool a trapped Barium ion to its motional ground state. We have developed a device to track the sun and keep light optimally coupled into a single mode fiber, delivering consistent light to the lab over a full day. This work is supported by NSF.

SM4G – 8 Investigation of stochastic resonance in an optical lattice, *Daniel Wingert, Krishna Pandey, Casey Scoggins, Grant Brown, Samir Bali, Miami University, Oxford, OH 45056.* We observe directed propagation of cold atoms confined in a modulated optical lattice. The directed propagation is resonantly enhanced by varying the photon scattering rate. A new theory based on atomic density wave contributions demonstrates how the modulated ground-state potentials and optical pumping rates conspire to generate this enhanced propagation. Funded by the US Army Research Office.

SM4G – 9 Fast nanopositioning stage for nanometer-scale vibrational quantum interferometry, *Michael Vayninger, Colin P. Lualdi, Paul G. Kwiat, Andrew P. Conrad, Spencer J. Johnson, Nathan Arnold, University of Illinois Urbana-Champaign, IL, 61801.* We have developed a fast, two-stage nanopositioning system capable of scanning over millimeter optical paths with nanometer resolution and vibrating with kHz frequencies. Interferometric techniques were implemented for characterizing the positioner's performance. Our stage will enable the characterization and operation of a two-photon interferometer designed to measure nanometer-scale vibrational signals. The work was supported by the U.S. Government.

SM4G – 10 Optical Cavity Design for Quantum Metrology, *Katya Mikhailova, Jacob Nelson, Francisco Elohim Becerra, University of New Mexico, Albuquerque, NM 87131.* Optical cavities can enhance light-matter interactions for diverse applications in metrology. We designed a cavity optimized for an atom-photon interface given experimental parameters including geometry, losses, and input/output couplings. We built a model cavity to characterize the properties of a physical cavity system. This work was supported by the NSF.

SM4G – 11 Locking multiple lasers to a single optical cavity, *Evan Johnson, Matt Grau, Old Dominion University, VA 23529.* Laser cooling requires multiple stabilized lasers. We are exploring the experimental simplification of locking several lasers to a single reference cavity. Compared to using a separate reference for each laser, this scheme can result in unwanted crosstalk. The goal of this project is to study and mitigate these effects. This work is supported by the Virginia Space Grant Consortium.

SM4G – 12 Time-Retarded Tripartite entanglement in Multimode Jaynes Cummings Models, *Nishan Amgain, Fernando Romero, and Imran Mirza, Miami University, Oxford, OH 45056.* We study three-photon entanglement in multimode cavities coupled with three two-level atoms. We find emergence of collapse and revival of entanglement due to time retarded atom field interaction which can find applications in building entanglement based well-controlled quantum memories.

SPECIAL TALK from 6:00 to 6:30

SpE7 – 1 ***Brad Conrad,*** *Director, Society of Physics Students & Sigma Pi Sigma*

"Physicist Random Walk: Careers, Graduate School, & Mental Maintenance"

7:00 Dinner at Christopher's, 28 E. Main St

It's a short walk from the Convention center - follow the group.

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Symposium organized by Samir Bali and Harold Metcalf