

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXVI - 14 September 2020.- Remote

[All times below are EDT]

SESSION LM2 from 11:00 to 12:30

Session LM2G: QUANTUM INFORMATION & QUANTUM OPTICS

11:00 – 12:30 Herman Batelaan, University of Nebraska, Presider

LM2G – 1 Clustering Algorithm for Predicting Quantum States in a Quantum Computer, *Feng Qian, Daniel J. Gauthier, The Ohio State University, Columbus, Ohio 43210*. I use a clustering algorithm to classify the output quantum state from the quantum Fourier transform circuit to determine the period of input data. I will describe the algorithm and its performance using simulated data.

LM2G – 2 High Fidelity Quantum Networks with Cold Atoms, *Andrew Pocklington, Shankar G Menon, Kevin Singh, Hannes Bernien, Pritzker School of Molecular Engineering, University of Chicago, Chicago, IL 60637*. Quantum networks have the potential to revolutionize many important technologies, from enhanced sensing to distributed quantum computing and secure quantum communication. We present a novel protocol utilizing a four-level scheme on Cesium qubits, and show a systematic approach to engineer high fidelity light matter interfaces based on photonic crystal cavities. Financial support is acknowledged from the University of Chicago.

LM2G – 3 Monte Carlo Simulation of Bell Inequalities, *Justin Willson, Eric Jones, Harold Metcalf, Stony Brook University, Stony Brook, NY 11794*. We studied the Clauser-Horne-Shimony-Holt (CHSH) inequality using numeric simulations of pure and mixed states. The probability of two-particle coincidence detection, maximum violation angles, and investigation of the different results in the value of S ($|S| \leq 2$ classically) for quantum and classical states will be discussed. Supported by the Simons Foundation through URECA.

LM2G – 4 Data Extraction Optimization of Strontium Atomic Interferometry, *Kunchaka Fonseka, Timothy Kovachy, Northwestern University, Evanston, IL 60208*. A Python-based simulation has been developed for the study of cooling and diffusion effects during imaging in atomic interferometry experimentation. Early investigation of the optimal fitting methods and apparatus parameters for data extraction and future applications of atomic interferometry will be discussed.

LM2G – 5 Hanbury Brown-Twiss (HBT) Explorations and Implications in the Digital Age, *Abhishek Cherath, Matthew Belzer, Eric Jones, and Harold Metcalf, Stony Brook University, Stony Brook, NY 11794*. A computational demonstration of the original HBT integral has been completed. We intend to build a replica of the original set up using digital tools instead of a correlation circuit. Future goals include making stellar, digital interferometers as well as a possible, novel approach to measuring gravitational waves. Supported by URECA and ONR.

LM2G – 6 Implementation of spin-to-charge conversion and investigation of charge dynamics in nitrogen-vacancy center defects in diamond, *Yanfei Li, Aedan Gardill, Matt Cambria, Shimon Kolkowitz, University of Wisconsin-Madison, WI, 53715*. We implemented a spin-to-charge conversion (SCC) technique to improve the signal-to-noise ratio of electron spin state readout of nitrogen-vacancy (NV) centers in diamond. We also developed a model to describe the charge dynamics in ensembles of NVs to determine the optimal parameters for the SCC technique. The work was supported by the U.S. Department of Energy, Office of Science.

LM2G – 7 Classical Rules for Qubit Spin-Flip Error Minimization. *Qile Su, Wes Campbell, and Robijn Bruinsma, University of California, Los Angeles, CA 90095*. Composite pulse sequences (CPSs) can suppress errors in the control of single spins. The design of CPSs is often presented with a geometric method based on a quantum treatment. We show how perturbing classical Larmor precession generates the same method, and how one can intuitively modify sequences for additional robustness.

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Session LM2H: OPTICAL SENSING & INSTRUMENTATION

11:00 - 12:30 Eric Borguet, Temple University, Presider

LM2H – 1 High-Harmonic Generation in the Water Window from mid-IR Laser Sources, *Keegan Finger, Klaus Bartschat, Kathryn R. Hamilton, Drake University, Des Moines, IA 50311*. We investigate the harmonic response of neon atoms to mid-IR laser fields (0.8 - 3 μ m) using the *ab-initio* R-Matrix with Time-dependence (RMT) method with a code optimized for high-performance supercomputing. The laser peak intensity and wavelength are varied to find optimal parameters for high-harmonic imaging in the water window. Supported by the NSF.

LM2H – 2 Polarization of water at the charged SrTiO₃/Water interface observed with second harmonic generation, *Truman Metz, Connor Rolleston, Somaiyeh Dadashi, Bijoya Mandal, Eric Borguet, Temple University, 1801 North Broad Street, Philadelphia, PA 19122*. Second harmonic generation has proven to be an effective probe to study interfaces. The SHG signal for the SrTiO₃/Water interface was recorded with varying pH values, in-turn allowing us to observe the alignment of water molecules in the electric field generated by pH induced charges at the interface. Supported by the Temple University Undergraduate Research Program (URP).

LM2H – 3 Hyperthermia of Magnetic Nanoparticles in Aqueous Solutions, *Wei Li, Dr. Maarij Syed, Nathaniel Fried, Rose-Hulman Institute of Technology, Terre Haute, IN 47803*. We explore the hyperthermia effects of magnetic nanoparticles (MNPs) of different sizes and concentrations in aqueous solutions when exposed to a magnetic field. We discuss their potential applications in hyperthermia treatment.

LM2H – 4 Delay Characterization of Cyclone V Field Programmable Gate Arrays (FPGAs), *Peter J. Menart, Caitlin L. Patterson, Liam M. Ramsey, Daniel J. Gauthier, Gregory P. Lafyatis, The Ohio State University, Columbus, OH 43210*. Ring oscillators are used to measure the delay of elements on an FPGA and characterize the variation of delay with respect to location. Knowledge of the variations in delay is crucial when using the FPGA for applications such as photon time-tagging. Supported by OSU Physics Department summer research scholarship.

LM2H – 5 Second Harmonic Analysis of the Magneto-Optic Response of Aqueous Magnetic Nanoparticles, *Nathaniel Fried¹, Maarij Syed¹, Codey Patterson², Wei Li¹, 1) Rose-Hulman Institute of Technology, Terre Haute, IN 47803 2) University of Michigan, Ann Arbor, MI 48109*. We study the aggregation dynamics of iron oxide magnetic nanoparticles (MNPs) using an AC Faraday rotation setup. In particular, the second harmonic of the response signal is analyzed since it correlates with the optical scattering of the MNPs. Results suggest a strong correlation with field frequency and particle size.

LM2H – 6 Development of a Computational Model for designing High-Efficiency Fresnel Lens Masks, *Rachel Hecht, Yunping Wang, Raven Dawson, Johnny Hergert, Amy Sullivan, Robert McLeod, University of Colorado Boulder, Boulder, CO 80309*. A computational model has been developed using beam propagation code to improve upon existing mask designs for creating gradient index Fresnel Lenses. The creation of this numerical program, along with an exploration into the relationship of a variety of simulated mask designs, will be discussed in the talk. Supported by NSF.

LM2H – 7 Stability and Characterization of Screen Printed Mesoporous Perovskite Solar Cells with a Carbon Electrode, *Hyunjin Hong, Adam Dvorak, David Tanenbaum, Pomona College, Claremont CA, 91711*. We fabricate and characterize perovskite solar cells with a mesoscopic scaffold of metal oxides and carbon nanomaterials infiltrated with a perovskite precursor solution. We combine imaging and analysis techniques with light soaking to investigate stability and degradation mechanisms over time. Supported by Pomona College grants, the Hirsch and Sontag families.

12:45 - 1:45

*Career Insights & Advice
with OSA Honorary Members*

William (Bill) Phillips and Elsa Garmire

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SESSION LM4 from 2:00 to 3:30

Session LM4G: OPTICAL LATTICES & ATOMIC CLOCKS

2:00 - 3:30 Amy Sullivan, University of Colorado, Presider

LM4G – 1 Using photoassociation to control atom population in an optical lattice clock, Brett Merriman, Haoran Li, Jonathan Dolde, Xin Zheng, Shimon Kolkowitz, Department of Physics, University of Wisconsin – Madison, WI 53706. Atomic interactions in optical lattice clocks can hinder clock performance, but can be mitigated by deterministically loading at most one atom per lattice site. We analyze how to achieve a filling of zero or one atom per lattice site using the 1S_0 - 3P_1 photoassociation transition of strontium with realistic experimental parameters. Financial support provided by Wisconsin Alumni Research Foundation, NIST, John Templeton Foundation, ARO, and Packard Foundation.

LM4G – 2 Coherent Population Trapping (CPT) Interrogation in Atomic Clocks. Dahlia Ghoshal¹, Juniper Pollock², Azure Hansen², William McGehee², John Kitching², 1) Columbia University, New York, NY 10027, 2) NIST, Boulder, CO 80305. Ramsey interrogation is generally considered more robust than continuous-wave (CW) interrogation for CPT clocks. However, power broadening and buffer gas collisions can create regimes in which CW offers better clock stability. We numerically simulate both techniques in a lambda system in rubidium to find their respective optimal regimes. Supported by NIST.

LM4G – 3 Designing a Deep-Sea Atomic Clock for Geological Research and Exploration, Liam Brennan¹, Leo Hollberg², 1) University of Florida, Gainesville, FL 32611, 2) Stanford University, Stanford, CA 94305. We designed an underwater Cesium-based Atomic Clock system for use in exploration, navigation, and geological research. This system will operate under high pressures, low temperatures, and utilize only small amounts of power for lengthy durations of time. Supported by Stanford University and The Leadership Alliance.

LM4G – 4 Developing a network of synthetically coupled mechanical oscillators to demonstrate topological effects, Ritika Anandwade¹, Ellen Carlson², Yaashnaa Singhal¹, Michael Castle¹, Caitlyn Battle-McDonald³, Sai Paladugu¹, Shraddha Agarwal¹, Bryce Gadway¹, 1) University of Illinois at Urbana-Champaign, Urbana, IL 61801, 2) Haverford College, Haverford, PA 19041, 3) Smith College, Northampton, MA 01063. Energy exchange between harmonic oscillators coupled in a network provides a mechanical analog to explore lattice transport phenomena. Using laser-based position monitoring and external driving by magnetic fields, we implement a new platform of synthetic mechanical network. Oscillators are tuned and coupled through remote feedback-control. We will present preliminary results. This material is based upon work supported by the NSF.

LM4G – 5 Observation and characterization of stochastic resonance in directed propagation of cold atoms, Kefeng Jiang, Alexander Staron, Ajithamithra Dharmasiri, Anthony Rapp, Samir Bali, Department of Physics, Miami University, Oxford, OH 45056. We report on the observation and first experimental characterization of stochastic resonance in a modulated optical lattice, i.e., a resonant enhancement in the conversion of random atomic recoils from spontaneous emission into directed motion. We study the dependence of stochastic resonance on modulation depth and lattice well depth. Funded by Army Research Office (ARO).

LM4G – 6 Modeling photoassociation in a multiplexed strontium optical lattice clock, Haoran Li, Brett Merriman, Jonathan Dolde, Xin Zheng, Shimon Kolkowitz Department of Physics, University of Wisconsin – Madison WI 53706. We have modeled the process of removing pairs of strontium atoms with a 1S_0 – 3P_1 photoassociation transition until one or zero atom is left on each lattice site. We also constructed a low-noise photodiode that will be used for intensity noise suppression of our lattice laser. Financial support provided by: Wisconsin Alumni Research Foundation, NIST, John Templeton Foundation, ARO, and Packard Foundation.

LM4G – 7 Analytic Calculation of Wannier Functions for Optical Lattice Experiments, Max L. Prichard, Peter E. Dotti, David M. Weld, University of California, Santa Barbara, Santa Barbara, CA 93106. We demonstrate the calculation of Maximally Localized Wannier Functions for general 2-D optical lattice experiments by mapping the procedure to an eigenvalue problem. We find this method to be more robust than numerical optimization methods and easily generalizable to higher dimensions and more complicated lattices. Supported by NSF, CAIQUE, and UCSB MRL.

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SESSION LM4 from 2:00 to 3:30

Session LM4H: NOVEL IMAGING METHODS - I

2:00 - 3:30 Michael Durst, Middlebury College, President

LM4H – 1 Using Talbot Interferometry for Coherent Imaging, *Mitchell C. Cutler, Daniel Hodge, Richard L. Sandberg, Eyring Science Center, Brigham Young University, 1 Campus Drive, Provo, Utah 84604.* Talbot Interferometry has been previously used to characterize wavefronts in x-ray free-electron (XFEL) lasers. We demonstrate how this same method can be used to directly measure the phase of objects through coherent imaging. This method eliminates the phase problem, making it much more robust than traditional coherent diffractive imaging. Funding from SLAC National Accelerator Laboratory through the U.S. Department of Energy - Fusion Energy Sciences Program.

LM4H – 2 Effects of Astigmatism on Ptychographic Coherent Diffractive Imaging Reconstructions, *Blake Buckner, Paul Arpin, Department of Physics, California State University, Chico, Chico, CA 95929.* Diffractive Imaging is a technique used in soft x-ray imaging to reconstruct the image of an object from its far-field diffraction pattern. Work in ptychography has shown improved reconstructions with the introduction of random masks. We investigate the effects of astigmatism in the illuminating beam on the quality of reconstructions. Supported by CSU, Chico College of Natural Sciences.

LM4H – 3 Toward Two-Photon Excitation with Supercontinuum Generation, *Ruben Vargas, Michael E. Durst, Middlebury College, Middlebury, VT, 05753.* We investigate supercontinuum generation as a long-wavelength excitation source for two-photon imaging. The split-step Fourier method propagates an ultrashort pulse through a photonic crystal fiber, including the effects of chromatic dispersion, self-phase modulation, and Raman scattering. We compare our numerical simulations in Python to experimental results. Supported by the Palen family through the Elizabeth Miller Palen '40 Fund.

LM4H – 4 Image tracking in Python for analysis of trapped crystal motion, *Adam Mulla, Catherine M. Herne, SUNY New Paltz, New Paltz, NY 12561.* When acted on by a laser, birefringent rhombohedral calcite crystals experience torque due to changes in angular momentum of the light. We use optical tweezers to trap and record crystal motion. We analyze the torque with a motion-tracking program in Python to quantify the rotation. Supported by RSCA.

LM4H – 5 Digital Plasmonic Holography with Iterative Phase Retrieval for Sensing. *Ryan M. Spies¹, Isaac M. Vliem¹, Britta G. Nordberg¹, Grace H. Cole¹, Marit A. Engevik¹, Evan A. Scharnick¹, Alexandre G. Brolo^{2,3}, and Nathan C. Lindquist¹, 1) Bethel Univ. St. Paul, MN 55112, 2) Department of Chemistry, University of Victoria, Victoria, BC, V8P 5C2, Canada, 3) Centre for Advanced Materials and Related Technologies (CAMTEC), University of Victoria, Victoria, BC, V8W 2Y2, Canada.* Digital holographic microscopy is an emerging technique that provides high-resolution imaging without lenses and captures both the amplitude and phase of light waves. Here, digital holographic techniques are combined with leakage radiation microscopy and used for lens-less, in-plane surface imaging with propagating surface plasmon waves. Supported by NSF.

LM4H – 6 Building of an electron dispersion compensator, *Jackson Lederer, Jared Murray, Hua-Chieh Shao, Bret Gergely, Martin Centurion, Herman Batelaan, University of Nebraska-Lincoln, Lincoln, NE 68588.* The project involves development of an apparatus designed to use electric and magnetic fields to focus the spread of electrons with different energy levels in time. The projection is to drop theoretical spread from 10 ns to 1 ns as has been confirmed by computer generated simulations. Supported by NSF.

LM4H – 7 Simulating two dimensional crystals in quadrupole traps. *Apurva Goel, Alexander Kato, Boris Blinov, University of Washington, Seattle, WA 98122.* Molecular dynamics (MD) is a robust tool to investigate the experimental conditions that facilitate different configurations in various trapping potentials. We discuss MD simulations we have devised for 2D ion crystals in ring trap potentials with the goal of optimization and scalability for large qubit systems in quadrupole traps. Supported by UW Royalty Research Fund.

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SESSION LM5 from 3:45 to 5:05

Session LM5G: ENTANGLED LIGHT & TWISTED LIGHT: APPLICATIONS

3:45 - 5:05 Irina Novikova, College of William and Mary, Presider

LM5G – 1 Ultra-Bright Entangled-Photon Pair Generation from III-V Microresonators, *Quynh Dang, Joshua Castro, Trevor J. Steiner, Lin Chang, Weiqiang Xue, Chenlei Li, Justin Norman, John E. Bowers, and Galan Moody, University of California-Santa Barbara, Santa Barbara, CA 93106.* Entangled-photon pairs are generated with spontaneous four-wave mixing (SFWM) from AlGaAs-on-insulator microring resonators with a Q-factor of over one million. This work demonstrates an ultra-bright, ultra-high-rate photon pair generation. The physics of the SFWM process and the experimental development will be discussed in the talk. Supported by NSF and AFOSR.

LM5G – 2 Optical Tweezer Geometries for Atomic Qubit Array. *Haley Nguyen, Jordan Kemp, Hannes Bernien, University of Chicago and Pritzker School of Molecular Engineering, Chicago, IL 60637.* Arrays of optical tweezers are an enabling technology for Rydberg atom quantum systems. We compare the effectiveness of multiple tweezer geometries for trapping single Cesium and Rubidium atoms, examining attractive and repulsive traps and exploring trap tightening with higher order Laguerre-Gaussian mode beams.

LM5G – 3 Classifying Laguerre-Gaussian (LG) Optical Modes via their Unique Multimode Fiber Output Patterns using a Deep Learning Approach, *Sofia Brown, Savannah Cuozzo, Irina Novikova, College of William and Mary, Williamsburg, VA 23185.* We classify basic LG modes by passing them through a multimode fiber and by using the output speckle images to train the convolutional neural network to identify the topological charge of the optical vortex. We explore fiber stability, image characteristics and training parameter optimization to maximize the recognition accuracies. This research was supported by AFOSR.

LM5G – 4 Storing Twisted Light in Warm Alkali Vapor, *Jianqiao Li, Kefeng Jiang, Kenneth DeRose, and Samir Bali, Department of Physics, Miami University, Oxford, OH 45056.* Laguerre-Gaussian optical modes, or twisted light, carry robust topological stability enabling their conversion into atomic coherence, followed by storage and later retrieval with phase features intact. Experimental and theoretical results are presented to verify both storage efficiency and topological retentivity of twisted light, with an "imposter" beam used for comparison. Supported by ARO and Miami University.

LM5G – 5 Resonance Raman of β -Carotene in Methanol with Structured Vector Light Beams, *Noah A. Hovde, Henry Meyer, Sandra Mamani, and R. R. Alfano, CUNY IUSL at CCNY, Physics Dept, The City College of New York, NY, NY 10031.* Resonance Raman scattering (RRS) lines from β -carotene-methanol solution for different polarizations and wavefronts of vector beams will be presented. The strength of Raman lines from a linearly polarized (LP) beam with OAM $L=0$ will be compared with that of circularly polarized (CP) light with $L=0$ and circular Laguerre-Gauss (LG), radially, and azimuthally polarized beams with $L=1$.

LM5G – 6 Conservation of orbital angular momentum distribution and extremal ellipticity for simple and general astigmatic Gaussian beams. *Duc H. Le¹, A. Pal¹, A. Qadeer¹, M. Kleinert², J. Kleinert³, S. Goel⁴, K. Khare⁴, and M. Bhattacharya¹,* *1) Rochester Institute of Technology, Rochester, NY 14623, 2) Willamette University, Salem, OR 97301, 3) Electro Scientific Industries, Portland, OR 97229, 4) Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016, India.* We demonstrate that the conservation of extremal ellipticity for an astigmatic Gaussian beam propagating in a rotationally invariant medium, initially identified by Lo et al. [Applied Optics 56, 2523 (2017)], is a direct consequence of the conservation of the orbital angular momentum distribution of the beam. Supported by NSF.

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SESSION LM5 from 3:45 to 5:05

Session LM5H: SPECTROSCOPY

3:45 - 5:05 Catherine Herne, SUNY New Paltz, Presider

LM5H – 1 Characterizing the Bound States of Strontium Dimers on the $5s^2\ ^1S_0 + 5s5p\ ^1P_1$ Potential. *Priyansh Lunia, Will Huie, Joshua Hill, Thomas Killian, Department of Physics and Astronomy, Rice University, Houston, TX 77005.* We present spectroscopic measurements and theory for the binding energies of strontium dimers on the $5s^2\ ^1S_0 + 5s5p\ ^1P_1$ potential. Leroy-Bernstein parameters and an effective potential describing data for multiple isotopes (including fermionic ^{87}Sr) will be discussed. These results will guide experiments using photoassociation to probe quantum gases of strontium. Supported by Rice University and NSF.

LM5H – 2 Towards Cavity-Enhanced Two-dimensional Infrared (2DIR) Spectroscopy, *Neomi A. Lewis, Myles C. Silfies, Anthony Catanese, Jay Rutledge, Grzegorz Kowzan, Alexander Kramer and Thomas K. Allison, Stony Brook University, Departments of Chemistry and Physics, Stony Brook, NY 11794.* We propose a new scheme for two-dimensional mid-infrared spectroscopy using cavity-enhancement techniques to study hydrogen bond networks. We will use pump and probe beams generated by optical parametric amplifiers. Phase cycling 2DIR spectroscopy is achieved using multiple frequency combs. My project focuses on planning layouts and integrating all necessary components. Supported by NSF, AFOSR and PSEG.

LM5H – 3 Rubidium Isotope Shift Measurement using Noisy Lasers, *Theodore J. Bucci¹, Jonathan Feigert¹, Michael Crescimanno¹, Brandon Chamberlain², Alex Giovannone²,* 1) *Youngstown State University, Youngstown, OH 44515,* 2) *The Ohio State University, Columbus, OH 43210.* We describe theoretically why the typical advanced undergraduate rubidium SAS laboratory works well with free-running laser diodes, demonstrate it experimentally using these lasers tuned to either principal near-infrared transitions, and show an extension of the laboratory using the modulation transfer spectroscopy method.

LM5H – 4 Two-photon Spectroscopy with Rubidium at 778nm, *River Beard, Nathan D. Lemke, Bethel University, Saint Paul, MN 55112.* Spectral line broadening in a $5S - 5D$ two-photon transition in natural rubidium is studied under varied environmental conditions, such as vapor cell temperature, magnetic field, and AC frequency of magnetic field-generating heating elements. Linear and circular polarization states of counter-propagating beams are used separately to interrogate at 778nm. Supported by NASA through the Minnesota Space Grant Consortium.

LM5H – 5 Power Narrowing via Optical Pumping, *Matthew C. Commons, Aaron Weiser, Jonathan Feigert, Michael Crescimanno, Department of Physics, Youngstown State University, Youngstown, OH 44515.* Saturated absorption spectroscopy (SAS) using multiple phase-independent optical fields reveals the effect of optical pumping on the formation of the depth and width of SAS features. We quantitatively compare experimental results of SAS processes in D1-D1 (pump-probe) and D1-D2 optical fields with a strictly population-based theoretical model of power driven resonance narrowing effects in ^{87}Rb .

LM5H – 6 Measurements of the Fine Structure of the Bismuth Negative Ion, *Sarah E. Spielman¹, Remington Ponce¹, John N. Yukich², Charles Cheung³, Marianna S. Safronova³, N. Daniel Gibson¹, and C. Wesley Walter¹,* 1) *Denison University, Granville, OH 43023,* 2) *Davidson College, Davidson, NC 28035* 3) *University of Delaware, Newark, DE 19716.* We have conducted preliminary measurements of the bound excited state of the bismuth anion, $\text{Bi}^- (6p^4\ ^3P_0)$. Using laser photodetachment spectroscopy, we measured the binding energy of the $\text{Bi}^-\ ^3P_0$ state and observed the photoexcitation of the $\text{Bi}^-\ ^3P_0$ state from the $\text{Bi}^- (6p^4\ ^3P_2)$ ground state. Supported by NSF and Denison University.

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SESSION LM6 from 5:20 to 6:15

Session LM6G: NOVEL IMAGING METHODS - II

5:20 - 6:15 Nathan Lindquist, Bethel University, Presider

LM6G – 1 Remote Axial Scanning and Light-Field Refocusing in a Temporal Focusing Microscope, *Sydney Hom, Kazuto Nishimori, and Michael E. Durst, Middlebury College, Middlebury, VT 05753.* Using Fourier optics, we simulate numerically the excitation and detection paths in a temporal focusing microscope. We demonstrate how changing the dispersion remotely scans the depth of the focal plane, and that Fourier light-field detection can re-focus these shifted planes computationally. Supported by the DeWitt Research Fund.

LM6G – 2 Polarimetry Studies on Birefringent Materials in Optical Tweezers, *Akza Sam, Faye Lyons, Catherine M. Herne, SUNY New Paltz, New Paltz, NY 12561.* We explore polarimetry as a method to quantify the torque produced when polarized light passes through a birefringent calcite crystal. We obtain images for six states of polarization, and process the images in MATLAB to produce a map which shows the change in polarization. Supported by RSCA.

LM6G – 3 Using Digital Holography to Visualize and Measure Mechanical Deflection and Thermal Expansion, *Daniel C. Jamison and Nathan C. Lindquist, Bethel Univ., St. Paul, MN 55112.* We used digital holography to visualize and measure small deflections of an aluminum beam. By subtracting two holograms of a loaded and unloaded beam, the amount of bend was quantified under different applied forces. By heating the beam, we were also able to visualize thermal expansion. Supported by NSF.

LM6G – 4 Coherent Diffraction Imaging and Sample Characterization, *Landon Schnebly, Richard Sandberg, Brigham Young University, Provo, UT, 84604.* We seek to use x-ray coherent diffraction imaging to study how things break at the nanometer scale. Preliminary sample characterization using electron backscatter diffraction was used to identify interesting sites and retrieve surface level information.

Session LM6H: NOVEL IMAGING METHODS - III

5:20 - 6:15 Klaus Bartschat, Drake University, Presider

LM6H – 1 Comparison of Computational Ghost imaging to Normal Imaging techniques. *Anjaneshwar Ganesan¹, Herman Batelaan¹, Serra Efren², 1) University of Nebraska, Lincoln, NE 68588, 2) Naval Research Laboratory, Monterey, CA 93943.* Using Dr. Shapiro's paper on computational ghost imaging, we are exploring whether the image quality of ghost imaging is equal to or better than normal imaging techniques, with varying exposure of light to the object. The experiments are simulated using Python. Supported by NSF.

LM6H – 2 Measuring Beam Pointing Fluctuations Using a Four-Quadrant Photodiode. *Edward J. Shea and Elizabeth A. Goldschmidt, Univ. of Illinois Urbana-Champaign, Urbana, IL 61801.* Mechanical vibrations from a closed-cycle cryostat and other equipment excite mechanical modes in an optical table, which causes laser beam position fluctuations downstream. We investigate these fluctuations in a new laboratory to isolate and characterize new sources of noise in future experiments. Funding: John A. Gardner Undergraduate Research Award.

LM6H – 3 Sideband Oscillation Phase Analysis of Reconstruction of Atto-second Beating By Two-Photon Transitions (RABBITT) Scans, *David Atri-Schuller¹, Gavin Menning¹, Kathryn R. Hamilton¹, Klaus Bartschat¹, Nicolas Douguet², Divya Bharti³, Anne Harth³ 1) Drake University, Des Moines, IA 50311, 2) Kennesaw State University, Kennesaw, GA 30144, 3) Max-Planck Institute for Nuclear Physics, 69117 Heidelberg, Germany.* We employ multi-sideband RABBITT-like schemes to investigate the dependence of the sideband oscillation phase on the probe field's intensity, frequency, pulse duration, and chirp parameters. Results from *ab-initio* time dependent Schrödinger equation calculations on atomic hydrogen are compared to predictions from lowest-order perturbation theory. Supported by the NSF and the Deutsche Forschungsgemeinschaft.

LM6H – 4 Extracting Phase Information on Continuum-Continuum Couplings, *Gavin Menning¹, David Atri-Schuller¹, Thomas Pauly¹, Kathryn R. Hamilton¹, Klaus Bartschat¹, Nicolas Douguet², Divya Bharti³, Anne Harth³ 1) Drake University, Des Moines, IA 50311, 2) Kennesaw State University, Kennesaw, GA 30144, 3) Max-Planck Institute for Nuclear Physics, 69117 Heidelberg, Germany.* We present a modified RABBITT scheme capable of isolating the continuum-continuum (CC) component of photoionization time delays. Calculations of the CC time delay in argon are carried out using the multi-electron R-Matrix with Time-dependence method (RMT) and will provide support for an ongoing experiment at the Max-Planck Institute in Heidelberg. Supported by the NSF and the Deutsche Forschungsgemeinschaft.

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SESSION LM7 from 6:30 to 7:15

LM7G – 1 Brad Conrad, Director, Society of Physics Students & Sigma Pi Sigma

“Physicist Random Walk: Careers, Graduate School, & Mental Maintenance”



Symposium organized by Samir Bali and Harold Metcalf