SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019.- Washington DC

PARTICIPANTS' LUNCHEON - Hoover Room - 12:00

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

POSTER SESSION - Coolidge Room Lobby - 1:00 - 4:30

Session LM3G (poster) 1:00 - 4:30, Coolidge Rm Lobby – Catherine Herne, SUNY New Paltz, Presider

LM3G – 1 Characterization of Defects in Organic Photovoltaic Devices via Thermo-reflectance Imaging. *Valerie Wang[1], Katheryn Kornegay[1], Alfred Molina[1], Tyler Jones[1], Adam Dvorak[1], Fernando Ayala[2], Sabrina Li[3], Catherine Horn[3], David Tanenbaum[1], and Janice Hudgings[1], 1) Pomona College, Claremont, California 91711, 2) San Jose State University, San Jose, California 95112, 3) Cornell University, Ithaca, New York 14850,* We use high-resolution thermo-reflectance imaging to characterize defects in organic photovoltaic devices. Thermo-reflectance is used to pinpoint and evaluate "hot spots" arising from electrical shunts such as point or edge defects, as well as a whole-cell background signal, under varying electrical bias conditions.

LM3G - 2 Polarization Switching and Frequency Locking in Vertical-Cavity Surface-Emitting Lasers Coupled by Bidirectional Optical Injection. *Tong Zhou and Hong Lin, Bates College, Lewiston, ME 04240.* We have investigated polarization behaviors of two vertical-cavity surface-emitting lasers coupled by optical injection. Polarization switching and frequency locking can occur in both single transverse mode regime and multi-transverse mode regime for a certain range of frequency detuning and injection powers.

LM3G - 3 Interference Pattern Structured Illumination Imaging Using Acoustical Waves. *Cayman Rogers, Dallin S. Durfee, Univ. of New Mexico, Albuquerque, NM 87131.* Our research team would like to use sound waves to create a structured illumination image. The idea behind this experiment is to project an interference pattern on a one-dimensional object, using two separate sources, and use information from the transmission signal to reconstruct the image. Supported by NSF.

LM3G - 4 Investigating Stochastic Resonance to Enhance the Resolution of CCD-based Thermo-Reflectance Imaging. *EliseAnne Koskelo and Janice Hudgings, Pomona College, Claremont, CA 91711.* CCD-based thermoreflectance imaging is a highly spatially resolved thermal imaging technique that requires averaging over many modulation periods to overcome a low signal to noise ratio. We develop a model of how noise can be used to maximize the thermal resolution of the technique via the stochastic resonance effect.

LM3G – 5 Interferometric Determination of Argon Pressure Within a Non-Uniform Gas Cell. *Bennett Atwater[1], Greg Smith[2], Steve Hageman[2], Lou DiMauro[2], 1) The College of William and Mary, Williamsburg, VA 23185, 2) Ohio State University, Columbus, OH 43210.* This project focusses on the construction and analysis of data from a Mach-Zehnder interferometer built to measure pressure within an open-ended gas cell. A two-photodiode system was utilized to generate elliptical data plots for relating pressure values to overall phase change in the apparatus. Supported by AFOSR.

LM3G – 6 High Speed Fluctuations in Surface-Enhanced Raman Scattering (SERS). *Britta G. Nordberg[1], Alexandre G. Brolo[2], and Nathan C. Lindquist[1], 1) Bethel Univ., St. Paul, MN 55112, 2) Univ. of Victoria, Victoria, BC V8P 5C2, Canada*. Surface-Enhanced Raman Scattering (SERS) occurs when a molecule is exposed to a highly concentrated electromagnetic "hotspot" on a metallic nanoparticle. However, random thermal fluctuations cause single-molecule SERS signals to also fluctuate. Here we analyze SERS at speeds up to 500 kHz and investigate various nanoparticle geometries. Supported by NSF.

LM3G - 7 Simulations of Nanoparticles for Surface-Enhanced Raman Scattering. *Marit A. Engevik and Nathan C. Lindquist, Bethel Univ., St. Paul, MN 55112.* The concept of electromagnetic "hotspots" in metallic nanostructures is central to Surface-Enhanced Raman Scattering (SERS). We examine the electric field distribution around metallic nanoparticles using COMSOL finite-element simulations and explore effects related to wavelength, particle geometry, and temperature. Supported by NSF.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019 - Washington DC

Session LM3G (poster) 1:00 - 4:30, Coolidge Rm Lobby – Catherine Herne, SUNY New Paltz, Presider

LM3G - 8 The Forgetful Qubit: Minimization of Decoherence in a Markovian System. *Cian C. Reeves[1], Arshag Danageozian[2], and Jonathan P. Dowling[2], 1)Trinity College Dublin, College Green, Dublin 2) Louisiana State University, Baton Rouge, LA, 70803.* Spin interactions cause qubit decoherence in a nitrogen vacancy center. A Markovian assumption was employed to simplify the problem and obtain an equation describing the qubit's coherence on a long timescale. A search algorithm known as simulated annealing was used to find dynamical decoupling sequences which minimized the qubit's decoherence. Supported by NSF and LSU.

LM3G - 9 Single-Atom Laser. *Quincy Webb and Imran Mirza, Miami University, Oxford, OH 45056.* Cavity quantum electrodynamics has emerged as an ideal platform to store and process information quantum mechanically. The single-mode based single-atom laser has already been realized (Nature 425, 268-271 (2003)). In this work we focus on the question of how the presence of additional cavity modes can influence laser operation. Supported by NSF.

LM3G - 10 Polarization in External Cavity Diode Lasers: Designing a New Laser Head Baseplate and Exploring ECDLs. *Jayson Calvi[1], Joseph D. Murphree[1,2], Zekai Chen[1,2], and Nicholas P. Bigelow[1,2], 1) University of Rochester, Rochester, NY 14627, 2) Center for Coherence and Quantum Optics, University of Rochester, Rochester, NY 14627*. We designed a new mount setup to hold commercial laser-diode heads in an ECDL on their side, allowing the polarization of the laser to be aligned with the diffraction grating lines regardless of which diode mount we use. Supported by NSF.

LM3G – 11 A Third Variable in the Wave-Particle Duality. *Michael Dapolito, Samet Demircan, Ian Schwartz, Martin Cohen, and Harold Metcalf, Laser Teaching Center, Stony Brook University, Stony Brook, NY 11794.* There exists a well-known relationship between visibility and distinguishability that quantifies the behavior of fringe contrast in a Young type interference experiment. However, one can set these two variables to zero with a non-zero output, suggesting that there may be a third variable needed to describe this behavior, entanglement. Supported by ONR and Simons Foundation.

LM3G – 12 Fresnel-based measurement of Complex Refractive Index in Turbid Media: Comparison with Mie Calculations. *Menaka Kumar[1], Sydney Rollins[2], Vinoin Vincely[3], Karthik Vishwanath[3], Lalit Bali[3] and Samir Bali[3], 1) North Carolina State Univ., Raleigh, NC 27695, 2) Whitman College, Walla Walla, WA 99362, 3) Miami Univ., Oxford, OH 45056.* We describe a total internal reflection-based method of measuring attenuation and refractive index in bio-relevant turbid phantoms that relies on an empirical modification to Fresnel theory. We find our measurements agree with Mie calculations, and with an Integrating Sphere coupled with the inverse adding doubling algorithm. Supported by NSF.

LM3G – 13 Stable 461 nm laser cooling system with injection locked laser diodes. *Brett Merriman, Xin Zheng, Haoran Li, Megan Tabbutt, Kelsey Jacobus, and Shimon Kolkowitz, Univ. of Wisconsin – Madison, WI 53706.* In order to rapidly and effectively laser cool all four stable isotopes of strontium on the $^1S_0$-$^1P_1$ transition for precision clock isotope shift measurements, we injection lock three 461 nm laser diodes. We achieve a total optical power of ~300 mW with rapid automated laser frequency tuning over >300 MHz. Supported by Univ. of Wisconsin – Madison Alumni Research Foundation, and Gordon and Betty Moore Foundation.

LM3G – 14 Optimization of Inner Shell Electron Excitation at Ultrahigh Intensities. *Zachariah Germain, David Milliken, Liam Kelley and B. C. Walker, University of Delaware, Newark, DE 19716.* Using a semi-classical approach, we model the production of k-shell holes for atoms in an ultrastrong laser field. We report the maximum number of k-shell excitations in Lithium, Neon, Krypton and Uranium ions as a function of the laser wavelength and intensity. Supported by NSF.

LM3G – 15 Examining the various methods of creating Holograms. *Chiu Yin Lee and Samet Demircan, Stony Brook University, Stony Brook, NY 11794*. Holography has various applications, such as from security to storage. To understand the basics of Holography various holograms ranging from transmission to two-channels were created using a Helium-Neon diode laser and household optical elements. Supported by the Simons Foundation and ONR.

LM3G – 16 The effects of elliptically and linearly polarized light on calcite behavior. *Mia L. Naglieri, Nolan M. Lotter, David J. Meer, and Catherine M. Herne, SUNY New Paltz, New Paltz, NY 12561*. The ability to optically trap objects is a powerful and useful tool. A good example of this is birefringent calcite rhombohedrons. When trapped by elliptically polarized light, calcite rotates with an elliptical precession. Under linearly polarized light it aligns along the polarization axis depending on its uniformity. Supported by SUNY New Paltz RSCA.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019 - Washington DC

Session LM3G (poster) 1:00 - 4:30, Coolidge Rm Lobby – Catherine Herne, SUNY New Paltz, Presider

LM3G – 17 Etaloning Laser Interference Analysis Spectrometry. *J. Nicholas Porter, Jarom S. Jackson, and Dallin S. Durfee, Brigham Young University, Provo, UT 84602.* We have developed a robust, inexpensive wavelength meter that passes monochromatic, collimated light through a series of etalon-like structures, collects the resulting interference pattern with a webcam, then uses it to calculate the light's wavelength within a few tens of picometers. With certain improvements, we expect to achieve picometer-level precision. Supported by Brigham Young University.

LM3G – 18 Digital Plasmonic Holography. *Isaac Vliem, Ryan Spies and Nathan Lindquist, Bethel Univ. St. Paul, MN 55112.* We image the phase and amplitude of surface plasmon waves by creating plasmonic holograms on a silver film. By collecting leakage radiation images and digitally processing the plasmonic interference patterns, we optimize digital plasmonic holography for applications in high-resolution imaging and sensing of nanoparticles. Supported by NSF.

LM3G – 19 Plasmonic nanopatch antennas with NV-Center Nanodiamonds. *Yu Hui Du and Svetlana Lukishova, Univ. of Rochester, Rochester NY 14627.* Silver nanocube-gold mirror nanopatch antennas with 20-nm NV-center nanodiamonds were prepared and investigated under 532-nm laser excitation. High-intensity spikes of photoluminescence from the silver nanocubes were observed. Photon correlation measurements from NV-centers within nanoantennas were carried out. AFM micrographs showed both the separate nanocubes and their aggregates. Supported by NSF.

LM3G – 20 External cavity diode laser based on a coated fiber tip reflection. *Zach Tebow and Nathan Lemke, Bethel Univ., St Paul, MN 55112.* We create a single-mode, tunable external cavity diode laser at 778 nm using a flat fiber connector with a coating of silver as the back mirror of a Fabry-Perot cavity. A narrowband optical filter enables mode-selection and tuning near 778 nm for rubidium spectroscopy. Supported by NASA.

LM3G – 21 Cooling Rb-87 Atoms Using Adiabatic Expansion in Microgravity. *Adelaide Pollard and Cass Sackett, Univ. of Virginia, Charlottesville, VA 22904.* The Cold Atom Lab on the International Space Station produces samples of cold, magnetically-trapped atoms. By slowly reducing the trapping fields, we have adiabatically expanded the trap by a factor of over 300. The resulting cooling yields an atom temperature of about 500 pK. Supported by NASA and the Univ. of Virginia.

LM3G – 22 Measurement of Dicke-narrowed optical transitions in warm alkali vapor for different buffer gas pressures. *Jianqiao Li, Ken DeRose, Kefeng Jiang, Linzhao Zhuo, and Samir Bali, Miami Univ., Oxford, OH 45056.* We demonstrate the quadratic dependence of the transition linewidth on the relative pump-probe beam angle - a defining signature of Dicke narrowing of the Doppler linewidth. We vary the buffer gas pressure thus varying the atomic spatial localization and hence the size of the "quantization box" causing the Dicke narrowing. Funded by ARO and Miami Univ.

LM3G – 23 Generating Optical Vortex Beam via Degenerate Four-Wave Mixing in Rubidium Vapor. *Kangning Yang, Hana Warner, and Irina Novikova, College of William and Mary, Williamsburg, VA 23185.* We report the observation of quantum-correlated probe and Stokes beams with large Orbital Angular Momentum (OAM) via a degenerate Four-Wave Mixing process in Rubidium vapor. By applying vortex on the probe beam, we experimentally confirm the conservation of OAM up to $l = 8$ mode.

LM3G – 24 Growth and optical characterization of antiferromagnetic PtMn thin films. *Lauren Gorman, Kathleen Oolman, and Virginia O. Lorenz, University of Illinois at Urbana-Champaign, Urbana, IL 61801.* Antiferromagnetic PtMn thin films are grown epitaxially and the effect of varying deposition rates and annealing temperatures on elemental composition is studied. We use time- domain thermoreflectance and the time-domain magneto-optic Kerr effect to probe the response of the prepared samples' magnetic order to optical heating. Supported by NSF.

LM3G – 25 Improvements for Atom Interferometry. *Daniel Rodriguez, Seth Aubin, College of William and Mary, Williamsburg, VA 23187.* Atom interferometers are the most precise force measurement instruments to date. These are very complicated devices that present many subsystems in order to operate. The poster presents three upgrades to such an instrument: an improved narrowband renumber laser, a precision laser trap vertical translator, and a high-power microwave amplifier system.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019 - Washington DC

Session LM3G (poster) 1:00 - 4:30, Coolidge Rm Lobby – Catherine Herne, SUNY New Paltz, Presider

LM3G – 26 Infrared Laser Spectroscopy of Thallium: Electron Affinity and Wigner Threshold Law Behavior. *Sarah E. Spielman, K.R. Patel, N.D. Gibson, and C.W. Walter, Denison Univ., Granville, OH 43023.* We have measured the electron affinity of thallium using tunable laser photodetachment threshold spectroscopy. A single *s*-wave threshold from the $Tl^-(6p^2\ ^3P_0) \rightarrow Tl(6p\ ^2P_{1/2})$ transition was observed using a crossed ion-beam-laser-beam apparatus scanned over photon energies 0.3-0.9 eV, indicating that the fine structure states of Tl^- are not bound. Supported by NSF.

LM3G – 27 Practical State Discrimination inspired by Deutschian Closed Timelike Curves. *Christopher Vairogs[1], Vishal Katariya[2], and Mark M. Wilde[2] , 1) Univ. of Florida, Gainesville, FL 32611, 2) Louisiana State Univ., Baton Rouge, LA 70803*. We show how a method for simulating a Deutschian closed timelike curve using multiple copies of a quantum state and multiple iterations of a quantum circuit allows practical state discrimination for multiple non-orthogonal states. We analyze this scheme for the discrimination of optical coherent states. Supported by NSF.

LM3G – 28 Impact of cavity-cavity coupling on the unconventional photon blockade in three-mode optomechanical cavities with Kerr type nonlinearity. *Avtej Sethi, and Imran Mirza, Miami University, Oxford, OH 45056.* Quantum states of light with a fixed photon number are useful in quantum informatics. In this regard, Sarma et al. **[**Phys. Rev. A 98, 013826 (2018**]** have recently studied unconventional photon blockade in a single three-mode optomechanical cavity. In this work, we extend their work to two coupled optomechanical cavities.

LM3G – 29 Modeling the Effects of Wavenumber Error in IPSII Images. *Benjamin Whetten, Jarom Jackson, and Dallin Durfee, Brigham Young University, Provo, UT 84602.* We are exploring an imaging method, known as IPSII, which uses interference patterns to obtain high-resolution images without using high numerical-aperture lenses. I am modeling the effects of mirror positioning errors on images generated by IPSII. Supported by Brigham Young University.

LM3G – 30 Dichroism in ionization of oriented Li(2p) atoms by circularly polarized laser radiation. *David Atri-Schuller[1], Klaus Bartschat[1], Nicolas Douguet[2], Daniel Fischer[3], (1) Drake University, Des Moines IA 50311, (2) Kennesaw State University, Kennesaw, GA 30144, (3) University of Missouri-Rolla, Rolla, MO 65409.* We investigate the response of laser-excited Li atoms prepared in the 2p, m = +1 state to circularly polarized infrared radiation with the same or opposite helicity of the initial state. Peak intensity, pulse length, and wavelength of the infrared laser are varied to simulate the conditions for an experiment at Missouri-Rolla. Supported by NSF.

LM3G – 31 Deterministic Routing of Single Photons in Multi-emitter Chiral Waveguide QED. *Bibandhan Poudyal, Imran Mirza. Miami Univ., Oxford, OH 45056.* Single-photon propagation is a key requirement in several quantum information processing protocols. Deterministic routings of few photons in single-atom chiral waveguide QED has already been studied. We investigate how to gain better control of routing phenomena in the presence of many-emitters. Supported by Miami University.

LM3G – 32 Magnetic Field Tuning of Liquid Crystal Microlasers. *Hana Warner[1], Mélanie Lebental[2], and Brigitte Pansu[3], 1) College of William and Mary, Williamsburg, VA 23185, 2) LPQM-UMR 8537, Ecole Normale Superieure de Paris-Saclay, Centrale Supelec, Université Paris-Saclay, France. 3) Laboratoire de Physique des Solides, UMR-CNRS 8502, Université Paris-Saclay, Orsay, France.* We demonstrate magnetic field tuning of droplet microlasers made with cholesteric liquid crystals doped with Pyrromethene 597 or Nile Red laser dye. We report a clear shift in Bragg modes and uniform behavior in whispering gallery modes in the experimental conditions used. Supported by NSF and DoD.

LM3G – 33 Precise, automated control of sample delivery for NV-NMR using microfluidics. *Gabriel E. Patenotte[1], Nithya Arunkumar[2], Matthew J. Turner[2,3], Mark Ku[3], Johannes W. Cremer[2,3] and Ronald L. Walsworth[2,3], 1) Williams College, Williamstown, MA 01267, 2) Center for Astrophysics, Cambridge, MA 02138, 3) Harvard University, Cambridge, MA 02138.* Nitrogen Vacancy centers in diamonds are picolitre-sensitive sensors used for high-resolution NMR spectroscopy, yet current experiments lack precise sample delivery techniques. We present an automatable microfluidic device that is inert, adheres impermanently to the diamond, and is capable of hyperpolarizing the NMR sample to improve resolution. Supported by the Moore Foundation and ARO.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019 - Washington DC

Session LM3G (poster) 1:00 - 4:30, Coolidge Rm Lobby – Catherine Herne, SUNY New Paltz, Presider

LM3G – 34 Identifying Gate Corruption in Quantum Circuits using Machine Learning. *Allee C. Rogers, Margarite L. LaBorde, and Jonathan P. Dowling, Hearne Institute for Theoretical Physics and Department of Physics & Astronomy, Louisiana State University, LA 70803.* As quantum computers advance, a way to diagnose circuit failures becomes necessary. We use machine learning to classify corrupted gates based on fidelity measurements taken with regards to known basis states. We identified these for multi-gate circuits of up to 11 qubits with no less than 90 percent accuracy.

LM3G – 35 Density Dependence of Dipole-Dipole Interactions Among Rydberg Atoms. *Nina P. Inman[1], Briana Strickland[2], Evan Dryfoos[2], Sean Bennett[2], Thomas J. Carroll[2], and Michael W. Noel[1], 1) Bryn Mawr College, Bryn Mawr, PA 19010 2) Ursinus College, Collegeville, PA 19426.* Ultra-cold highly exited atoms can exchange energy through a dipole-dipole interaction. Two-body interactions, np + np → ns + (n+1)s, are tuned into resonance with a static electric field. We study the density dependence of this interaction. As the density of atoms increases, higher-order interactions become observable and the resonance broadens. Supported by NSF.

LM3G – 36 Investigating the Acoustical Sensitivity of an Optical Tweezer, *Connor Davis, Bella Avalos, and Mark Raizen, Univ. of Texas, Austin 78705.* We created an ultra-weak sound source using a cylindrical piezoelectric crystal vibrating in its fundamental mode. By gradually decreasing the sound wave amplitude of a pure tone, we can experimentally verify that a trapped nanoparticle in an optical tweezer is more acoustically sensitive than most commercial microphones.

LM3G – 37 Pump Probe Spectroscopy of Ultrafast Molecular Dynamics. *Daniel Lucero, Dillon Anderson, Paul Arpin, California State University, Chico, CA 95929.* We will test a simple model for the probe wavelength dependence of oscillations due to molecular vibrations observed in transient-transmittance spectroscopy in two model systems. We present our progress on the development of a femtosecond transient absorption spectrometer and preliminary results on the laser dye IR-125. Supported by Chico STEM Connections Collaborative (CSC2).

LM3G – 38 Fourier Transform Spectroscopy in the Visible Range. *Tyler Hatch and Jenny Magnes, Vassar College, Poughkeepsie, NY 12604.* We present an undergraduate laboratory that utilizes Fourier spectroscopy with two lasers to demonstrate the measurement technique. A Michelson interferometer is used to determine the wavelength of a He-Ne laser by scanning the position of a mirror and comparing the number of observed fringes with those of the reference beam.

LM3G – 39 Effects of Astigmatism on Coherent Diffractive Imaging Reconstructions. *Blake Buckner and Paul Arpin, California State University, Chico, Chico, CA 95929-0202.* Coherent Diffractive Imaging is a technique used in soft x-ray imaging to reconstruct the image of an object from measurements of its far-field diffraction pattern. In many configurations, off-axis spherical mirrors illuminate the object. We numerically investigate the effects of astigmatism in the illuminating beam on the quality of reconstructions. Supported by CSU, Chico College of Natural Sciences.

LM3G – 40 Predicting CCD-based Metrological Uncertainty of the Long Trace Profiler. *Mit Patel[1,2], Jun Qian[1], Joseph Sullivan[1], Janet Sheung[1,2], Lahsen Assoufid[1], 1) Argonne National Laboratory, Lemont, IL 60439 2) Vassar College, Poughkeepsie, NY 12604.* A CCD is calibrated to investigate the error it introduces in diffraction-based angular deflection measurements taken by Argonne National Lab's Long Trace Profiler. The calibration data is then used to make noise models of every pixel to establish a procedure for optical slope measuring instruments to reliably predict CCD-based metrological uncertainty. Supported by Argonne National Lab.

LM3G – 41 Light Identification Using Artificial Neural Networks. *Aidan Lambert[1], Chenglong You[1], Narayan Bhusal[1], Roberto de J. Leon-Montiel[2], Amir Javaid[1], and Omar S. Magana-Loaiza[1]***, 1)** *Louisiana State Univ., Baton Rouge LA 70803. 2)Instituto Ciencias Nucleares, Universidad Nacional Autónoma de México 70-543 04510 Cd. Mx. México.* By utilizing the self-evolving features of neural networks, we reduce the number of measurements required to discriminate thermal and coherent light at single-photon levels with mean photon numbers below one to under a hundred measurements. With respect to conventional methods, this represents an improvement of several orders of magnitude.

LM3G – 42 Investigation of the Phase Structure of Hermite-Gauss Laser Beams. *Nathan Murillo[1], Reeta Vyas[2] and Surendra Singh[2], 1) Oklahoma Baptist University, Shawnee, OK 74804, 2) Univ. of Arkansas, Fayetteville, AR 72701.* Phase profiles of Hermite-Gauss laser beams are experimentally investigated using their interference with a plane wave and diffraction by a single slit. The results are compared with those for Laguerre-Gauss vortex beams and implications for determining beam parameters based on diffraction and interference are discussed. Supported by NSF.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019 - Washington DC

Session LM3G (poster) 1:00 - 4:30, Coolidge Rm Lobby – Catherine Herne, SUNY New Paltz, Presider

LM3G – 43 Correlating Multiphoton-Absorption-Induced Luminescence (MAIL) with Morphology in Nanostructured Noble Metals. *Anna Grafov[1], Farah Dawood[1,2], John T. Fourkas[1], 1) Univ. of Maryland, College Park, MD 20742, 2) Hamilton College, Clinton, NY 13323.* Incident light coupled with surface plasmons on noble metals results in strong localized electromagnetic field enhancement. When low-intensity, ultrafast pulses of near-infrared light impinge upon noble-metal nanostructures, highly efficient, broadband luminescence is produced. We examine the relationship between this luminescence and the geometries of gold and silver nanostructures. Supported by NSF.

LM3G – 44 Photon Entanglement as a diagnostic tool for Alzheimer's Disease. *Baibhav Sharma and Enrique J. Galvez, Colgate University, 13 Oak Drive, Hamilton, NY-13346.* Quantum entanglement is one of the cornerstones of quantum mechanical phenomena. Our experiment uses entangled photons and quantum state tomography to characterize the state of post mortem brain tissues and hence differentiate between Alzheimer's Disease affected samples and healthy ones, eventually providing a diagnostic method. Supported by Picker Interdisciplinary Science Institute.

LM3G – 45 Polarization Control and Stabilization for High-Precision Deuterium Spectroscopy. *Neomi Lewis[1], Oana Bazavan[2], Vitaly Andreev[3], Lothar Maisenbacher[3], Alexey Grinin[3], Arthur Matveev[3], Randolf Pohl[3], Theodor W. Hänsch[3] and Thomas Udem[3], 1) Stony Brook Univ., Stony Brook, NY 11794 2) Oxford Univ., Oxford OX1 2JD, UK 3) Max Planck Institute of Quantum Optics, Garching bei München 85748, Germany.* In order to perform a high-precision measurement of 2S-nP transitions in deuterium, polarization-control of the spectroscopy laser beam is required. This project uses an in-line polarization controller to stabilize the desired polarization states after the fiber by using the polarization of the back-coupled beam through the fiber as a signal. Supported by the DAAD.

LM3G – 46 Quantum Optics in an Undergraduate Laboratory. *Jill Ireland, Amy Lytle, Franklin and Marshall College, Lancaster, PA 17603.* Experiments in quantum optics are now accessible to undergraduates due to availability of correlated-photon production and detection methods. We report work to implement these experiments at Franklin & Marshall College. We hope to integrate these experiments with Quantum Interactive Learning Tutorials (QuILTs) to enhance student understanding of quantum phenomena.

LM3G – 47 Spin-orbit Entangled Vector beams are Majorana-like. *Sandra Mamani[1], Daniel A. Nolan[2], Lingyan Shi[3], Robert R. Alfano[1], 1) City College of the City Univ. of New York, New York, NY 10031 2) Corning Research and Development Corporation, Corning, NY 14830 3) Univ. of California San Diego, La Jolla, CA 92093.* We show mathematically that a special group of mixed spin-orbit entangled vector beams are Majorana-like particle. This Majorana-photon and its anti-photon are the same, following the state function of a Majorana self-transposed $\psi = \psi^*$. A Majorana-photon has the characteristic of chiralities in its SAM and OAM, and topologically invariant. Supported by Corning Incorporated Foundation and ARO.

LM3G – 48 2D Trapped Barium Ion Crystals as Quantum Computation Hardware. *Boris Blinov, Ali Hasanzadeh, Megan Ivory, Alex Kato, Univ. of Washington, Seattle, WA 98105.* Quantum computation has thus far been limited by number of available qubits. Trapped ions as one of the leading platforms for Q.C., have been performed in linear Paul traps. Recent work from the Duan group shows the possibility of building 2D traps for ions and take the maximum qubit limit further.

LM3G – 49 Determining the Relative Concentration and Efficiency of Incorporated Centers in Europium Doped Gallium Nitride with Different Structures . *Veronica Cisneros [1], Ruoqiao Wei [2], Hayley Austin [2], Volkmar Dierolf [2] 1) University of Rochester, Rochester, NY 14627, 2). Lehigh University, Bethlehem, PA 18015,* The in situ doped samples were studied through combined excitation emission spectroscopy showcasing sites and their relative concentration. We found that the multi-layered sample with optimal growth parameters demonstrated centers with strong energy emission that serve as a promising candidate for the application of the europium ion within LED material systems.

LM3G – 50 Fabrication of Femtosecond Laser-Induced Crystals in Lithium NioboSilicate 30: The Effects of Polarization Angle on Orientation and Growth Rate. *Rutendo Jakachira[*1], Courtney Au-Yeung[2], Evan Musterman[2], Himanshu Jain[3],Volkmar Dierolf[1], 1) Drew University, 07940, Madison NJ, 2) Lehigh University, 18015, Bethlehem PA.* Optical and Electron microscope inspections reveal a dependence of light polarization on growth of crystals in glass using a fs laser. Critical for these experiments was an algorithm based on a half-wave plate that insured constant laser intensity for varying polarization directions.

LM3G – 51 Stability of Vortex Beams Through Atmospheric Turbulence. *Emily Crkvencic, Ziyi Zhu and Zhimin Shi, Univ. of South Florida, Tampa FL, 33620.* Vortex beams are promising candidate for high-capacity free-space communication. We study experimentally the stability of vortex beams after propagating through a turbulent channel. Our study show that the orbital angular momentum of light doesn't increase the beam stability, but the polarization profile of vectorial vortex beams is much better preserved.

LM3G – 52 Improving Laser Transport Of Ultracold Atoms Using Adaptive Optics. *Jordan O'Kronley, Michael Bishof, Argonne National Laboratory, Lemont IL, 60439.* In atomic, molecular, and optical physics, ultracold atom transport using an optical trap is a widely used technique to prepare atoms for a broad spectrum of experiments. By utilizing adaptive optics as apposed to the standard fixed lens, a more stable system will improve long range transport of ultracold atoms. Supported by DOE and Univ. of Chicago.

Group Photo Break 4:30 – 4:40 PM - - - PLEASE assemble at the designated place !!!

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXV - 16 September 2019 - Washington DC

Session LM4G (oral): 4:45 - 6:00 PM, Coolidge Room – Klaus Bartschat, Drake Univ. Presider

LM4G - 1 Modulated Amplitude Reflectance Spectroscopy to Spatially Map Charge Carrier Density and Mobility in Organic Field Effect Transistors. *Yannai Kashtan, Ricardo Espinoza, David Tanenbaum, Janice Hudgings, Physics and Astronomy Department, Pomona College, Claremont, CA 91711.* Organic field effect transistors are used as a model system to explore charge transport in semiconducting polymers. Modulated amplitude reflectance spectroscopy is used to spatially map the carrier density and to quantify the carrier mobility. The effect of carrier density on mobility is assessed independently of the lateral field. Supported by Pomona College SURP program.

LM4G - 2 Modeling Torques on Calcite in Optical Trapping, *David J. Meer, Mia L. Naglieri, and Catherine M Herne, SUNY New Paltz, New Paltz, NY 12561.* Describing the forces on an object is key to their manipulation. We demonstrate the effect of force and torque on rhombohedral calcite due to transmission and refraction of light in an optical trap. The behavior we see experimentally is predicted by our model and a match with non-birefringent cubes. Supported by SUNY New Paltz RSCA.

LM4G - 3 Time-resolved Modeling of the Rovibrational Molecular Dynamics in Laser-excited Oxygen Molecules. *Thomas Pauly[1]; Paul Abanador[2], Uwe Thumm[2]; 1) Drake Univ., Des Moines IA 50311, 2) Kansas State Univ., Manhattan, KS 66506.* We solve the time-dependent Schrödinger equation within the Born-Oppenheimer approximation to examine vibrational and rotational dynamics in the oxygen molecule using a pump-probe setup. In order to see possible effects of rotation with the vibrational dynamics, the peak intensity and pulse length of the laser pulse were varied. Supported by NSF, DOE, and NSF-REU.

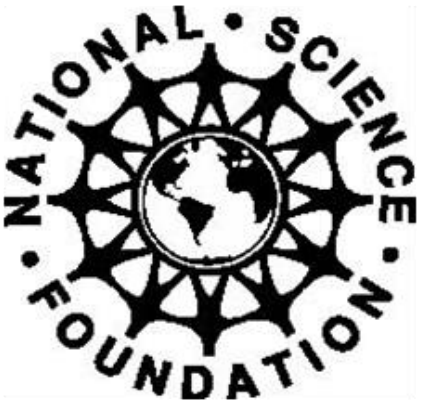
LM4G - 4 Vibrational Resonances and Propagation Modes in a Dissipative Optical Lattice. *Alexander Staron, Ajithamithra Dharmasiri, Anthony Rapp, and Samir Bali, Miami University Oxford, OH 45056.* We present observations of Zeeman light-shifts, Raman vibrational modes, and Brillouin propagation modes in dissipative optical lattices which agree with predictions from a two-level atom model. We clearly demonstrate a splitting of the Brillouin resonance when the probe beam is shifted spatially. We discuss the prospects of observing stochastic resonance. Supported by ARO.

LM4G - 5 Evaluating the Performance of Large-Scale Quantum Networks. *Aliza Urooj Siddiqui, Corey Matyas, Sumeet Khatri, Jonathan P. Dowling, Louisiana State Univ., Baton Rouge, LA 70803.* We consider three figures of merit for evaluating the performance of global-scale quantum networks: average global connection time, average point-to-point connection time, and average largest entanglement cluster size. We obtain upper and lower bounds on these quantities that apply to networks of arbitrary size and topology. Supported by Army Educational Outreach Program and NSF.

LM4G – 6 Fabrication and Characterization of Screen-Printed Perovskite Solar Cells. *Adam Dvorak, Phuong Nguyen, David Tanenbaum, Pomona College, Claremont, CA 91711.* Perovskite solar cells (PSCs) are an alternative to mainstream silicon solar technologies due to cost-efficient materials, competitive power conversion, and ease of fabrication. We fabricate PSCs by screen printing inks of Titania, Zirconia, and Carbon and infiltrating them with a Perovskite precursor, then record IV curves and spatial current maps. Supported by Pomona College grants, the Hirsch and Sontag families.

Dinner at Lebanese Taverna, 2641 Conn. Ave 6:30

It's a short walk northeast from the Marriott - follow the group.



Symposium organized by Samir Bali and Harold Metcalf