SYMPOSIUM ON UNDERGRADUATE RESEARCH

(this symposium is SpE24)

Division of Laser Science of A.P.S - LS XXXIX - 9 October 2023 - Tacoma, WA

PARTICIPANTS' LUNCHEON - Chambers Bay Ballroom - 12:00

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

POSTER SESSION - Chambers Bay Ballroom - 1:00 - 3:00

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

Peter Delfyett, University of Central Florida, Presider

SM3G – 1 Quantum Decoherence of Entangled Photons to Detect Hypoxia, *Leia Francis, Enrique J. Galvez, Colgate University, Hamilton, NY 13346.* The goal of this research is to use polarization-entangled photons as a diagnostic tool for Hypoxia, a deficiency of oxygen in the brain. Using quantum state tomography, we used the tangle and linear entropy of the state of the photons to distinguish between photons that pass through diseased and control tissue samples.

SM3G – 2 Characterization for an entangled photon pair source, *Jichu Shi, Nicholas J. Sorensen, Benjamin D. Smith, Lindsay J. LeBlanc, John P. Davis, University of Alberta, Edmonton, AB, T6G 2E9, Canada.* We report on progress towards a narrowband photon source based on cavity enhanced Parametric Down Conversions. Such a photon source could be utilized further in quantum information processing technologies. Supported by Ultracold Quantum Gases Lab at the University of Alberta, and Quanta CREATE program.

SM3G – 3 Study of diffractive optics for multiplexed quantum repeaters, *Aishi Guha, Noah Lindsell, Paul Kunz, University of Texas at Austin, Austin, TX 78705.* We report on the simulation and experimental study of an optical system to multiplex read/write beams at 121 distinct angles on an atomic Duan-Lukin-Cirac-Zoller (DLCZ) quantum repeater scheme. The performance of optics to steer the beam effectively and a custom diffraction grating are analyzed and optimized for the purpose of speeding up the DLCZ protocol.

SM3G – 4 Propagation of cold trapped atoms in a precisely predictable, arbitrary direction by weak modulation of the confining optical lattice, *Stone Oliver, Luke Schmeltzer, Danny Wingert, Chanakya Pandya, Samir Bali, Miami University, Oxford, OH 45056.* We report experimental progress on the controlled transport of cold ^{85}Rb atoms randomly diffusing within a two-dimensional dissipative optical lattice. Using a quasi-periodic lattice modulation permits directed atomic transport in a precisely predictable, arbitrary direction, without requiring a detailed knowledge of the lattice geometry. We gratefully acknowledge funding by the US Army Research Office.

SM3G – 5 Managing Memory Error: Enhancing Stability and Gate Performance in Trapped Ion Quantum Computing, *Kaitlyn Avison[1,2], Andrew Malm[2], Bruce Tiemann[2], Evan Mendoza[2], Abigail R. Perry[2] , 1) University of Massachusetts Lowell, Lowell, MA 01854. 2) Quantinuum, Broomfield, CO 80021.* Among different platforms for quantum computing, trapped ions stand out due to long qubit coherence times and high gate fidelities. However, these systems are not immune to environmental influences and technical instabilities that may introduce errors. This work examines two crucial factors affecting performance: geomagnetic field fluctuations and intensity instabilities.

SM3G – 6 1762 nm laser stabilization for trapped Ba+ ion control, *Richard Kim, Boris Blinov, University of Washington, WA 98195.* We stabilized a 1762 nm laser for trapped Ba+ ion control by using a Pound Drever Hall (PDH) technique. We used an In-phase Quadrature (I/Q) modulator and an Acousto Optic Modulator (AOM) to generate side-bands to the laser. As a result, we obtained a 1762 nm laser with high stability.

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Peter Delfyett, University of Central Florida, Presider

SM3G – 7 Demonstration of the Hanbury Brown and Twiss (HBT) Effect for Undergraduate Laboratories, *Matthew Belzer, Eric Jones, Harold Metcalf, Stony Brook University, NY 11790.* We built an apparatus to test the HBT effect by measuring the intensity correlation of a chaotic light source. A preliminary analysis of the single and coincidence counts from two photomultiplier tubes shows a correlation peak; however, further work needs to be done to confirm it. Supported by the ONR.

SM3G – 8 Development and characterization of avalanche photodiode single photon detectors, *Kate Wolchok, Apoorva Bisht, Hiro Nakamura, University of Arkansas, Fayetteville AR 72701*. We have built our own APD (avalanche photodiode) detector, and with a commercially produced APD, plan to characterize different properties of the two to further optimize our home-built detector. Measurements of dark count vs temperature and profiling pulses at breakdown and overvoltage are used to compare the two. Research was funded by the University of Arkansas through the Honors College Research Grant.

SM3G – 9 Time Delay Quantum Eraser, *Bill Luo, Enrique J. Galvez, Leia Francis, Colgate University, Hamilton, NY 13346.* We used the birefringent properties of quartz to test a time delay polarization quantum eraser. By sending down-converted photons through a Mach-Zehnder Interferometer setup, we created distinguishable paths with time delay that could be erased after the interferometer. Our setup produced interference and noninterference patterns that are consistent with theory. Supported by NSF.

SM3G – 10 Three-Photon Hong-Ou-Mandel Effect in Cavity Quantum Electrodynamics, *Hannah McDougall, Imran Mirza, Miami University, Oxford, OH 45056.* We investigated how the strong light matter interaction in cavity quantum electrodynamics affects the three-photon Hong-Ou-Mandel effect. A quantum jump approach was used with both equal and unequal time detection to determine the interference probabilities and photon-photon bunching and anti-bunching results. This work was supported by the College of Arts and Science at Miami University.

SM3G – 11 Simulating velocity dependence of the Adiabatic Rapid Passage (ARP) force, *Christian Zaprianov, Harold Metcalf, Stony Brook University, Stony Brook, NY 11794*. The ARP force acts on atoms through a resonant light pulse sequence, facilitating efficient momentum exchange. This study simulates the process to predict the velocity dependence of the ARP force. We compare our simulated and experimental results to validate our theoretical model and offer guidance for future experiments. This work was supported with funding from Undergraduate Research & Creative Activities (URECA) program at Stony Brook University, and ONR.

SM3G – 12 Implementation of saddle coil apparatus for multidimensional vector electromagnetically induced transparency (EIT) magnetometry, *William Torg, Irina Novikova, Mario Gonzalez Maldonado, Eugeniy Mikhailov, College of William and Mary, Williamsburg, VA 23187.* I designed and built a 2D saddle coil assembly around a Rb vapor cell to create homogenous magnetic fields for a 3-dimensional EIT vector magnetometry. The coils' calibration using a commercial fluxgate magnetometer and the EIT Magnetometer produce a relative discrepancy of less than 2 percent. This work was supported by DARPA under the US Army Research Office.

SM3G – 13 Reinforcement learning for optimization and control of ultracold quantum gases, *Nicholas Milson, Arina Tashchilina, Anna Prus-Czarnecka, Tian Ooi, Zaheen F, Lindsay J. LeBlanc, University of Alberta, Edmonton, AB, T6G 2E1, Canada*. Producing neutral-atom Bose-Einstein condensation requires ultrahigh vacuum, stable lasers, and meticulous conditions. Even with efforts, atom number drift occurs due to complex steps and parameters. We tackled this with environmental sensors and machine learning to predict drift. Combining a reinforcement learning neural network, we optimized BEC production for high-quality data.

SM3G – 14 Generation of extremely large aspect ratio optical beams, *Kerry Fracasso, Zhanna Rodnova, Tobias Saule, Carlos Trallero, University of Connecticut, Storrs, CT 06268*. We created Bessel-Gaussian beams with an aspect ratio of 12500 and a FWHM of 120 micrometers over 1.5 meters. The effective Rayleigh range was 1.5 meters. This was achieved by placing a weak negative lens in front of a shallow-angle axicon.

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SM3G – 15 Storage of optical vortex beams in warm alkali vapor, *Reese Tyra, Benny Makias, Muhammed Khan, Samir Bali, Miami University, Oxford, OH 45056.* We store Laguerre-Gaussian (LG) "optical vortex" beams in warm Rb87 vapor for potential applications in quantum memory. We demonstrate that the vortex can be stored for hundreds of microseconds, and measure the fidelity of the retrieved pulse spatial profile. The LG beams are created using a Spatial Light Modulator. We gratefully acknowledge funding from the US Army Research Office.

SM3G – 16 Angle Sensitivity Optimization of Vector Atomic Magnetometry using Electromagnetically Induced Transparency (EIT) in Rubidium Vapor, *Owen Rollins, Mario Gonzalez Maldonado, Irina Novikova, Eugeniy Mikhailov, William & Mary, Williamsburg, VA 23187.* Detecting Zeeman splitting atomic sublevels via narrow EIT resonances enables precise magnetic field measurement, where relative amplitudes of EIT resonances provide information about magnetic field direction. Using a polarization modulation lock-in technique with various noise reductions, we achieved azimuthal angular sensitivity of 0.1-1°, depending on field orientation. This work was supported by DARPA under the US Army Research Office.

SM3G – 17 Velocity Selective Resonances from a Novel Optical Force, *Michael Wahl, Yifan Fang, Edoardo Buonocore, Harold Metcalf, Stony Brook University, NY 11794*. Adiabatic Rapid Passage (ARP) allows us to create optical forces much stronger than the radiative force by eliminating the wait for spontaneous atomic emission. We find that the ARP force depends unintuitively on the velocity of the atoms it pushes. This work was supported by the Office of Naval Research.

SM3G – 18 Multipartite entanglement in multimode cavity quantum electrodynamics (cQED), *Umar Arshad, Mahir Rahman, Imran Mirza, Miami University, OH 45056*. We address the challenge of the single-mode Jaynes-Cummings model by extending it to multiple modes, unveiling insights into multipartite entanglement's time evolution. Our study advances cQED's leading quantum computing capabilities. This work is funded by Miami CAS startup funding.

SM3G – 19 Retrieval of Gravitational-lensing diffractive features from Astronomical Images, *Eli Mayes, Valeria Rodríguez-Fajardo, Enrique J. Galvez*, *Colgate University, Hamilton, NY 13346.* We used images of Einstein rings taken by the Hubble Space Telescope (HST) to investigate if their Fourier analysis reveals the diffractive features predicted theoretically for the gravitationally lensed light. We found 2 images that have Fourier transforms that are consistent with the expected diffraction patterns from a symmetric system. Supported by NSF.

SM3G – 20 Raman scattering from in phase and out of phase of H_2O bonds due to solvation of the ions from sodium chloride, *Inoussa Kabore, Sandra Mamani, Robert Alfano, The City College of New York, New York, NY 10031.* Raman spectra of water measured in a solution with sodium chloride (NaCl) from 0 M to 5 M. Raman intensity of OH mode from in phase at 3200 cm^{-1} of water is affected more than out of phase at 3400 cm^{-1} by NaCl. Wavenumber 1648 cm^{-1} mode is not affected much.

SM3G – 21 Dewetted Gold Nanocrystal Samples for Atomic Scale X-Ray imaging, *Nash Karrington, Joshua Miller, Andres Herrera, Landon Schnebley, Nicholas Porter, Jason Meziere, Richard L. Sandberg, Brigham Young University, Provo, UT 84604.* Bragg Coherent Diffraction Imaging has a spatial resolution of a few nanometers currently. In order to push the resolution to near atomic scale we develop and characterize appropriate gold nano crystal samples. We will present the sample fabrication recipe and characterization needed to develop this powerful new technique. Funding from DOE-BES DE-SC022133.

SM3G – 22 Recurrences and Kolmogorov-Sinai Entropy of *C. elegans* Locomotion, *Claire Dwyer, Jenny Magnes, Susannah G. Zhang, Vassar College, N, 12604.* Locomotory time series from wildtype *C. elegans* are analyzed using optical diffraction techniques to calculate the Kolomogorov-Sinai (KS) entropy for the system. We construct recurrence plots and use Faure and Lesne's method to compute KS entropy. We discuss potential connections between computed KS entropy, recurrence quantification divergence, and Lyapunov spectra.

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Peter Delfyett, University of Central Florida, Presider

SM3G – 23 Two-Photon Fluorescence Spectra of Long Wavelength Dyes, *Jewel Ashbrook, Hazel Traw, Michael E. Durst, Middlebury College, Middlebury, VT 05753.* We present two-photon absorption spectra of four long-wavelength dyes used in fluorescence guided surgery in the excitation wavelength range of 1025-1800 nm. We show the impacts of water absorption on fluorescence spectra at longer wavelengths and in thicker samples. Supported by the NIBIB of the NIH (R15EB025585).

SM3G – 24 Comparison of High Harmonic Generation Yields in Benzene and Cyclohexane, *Stephanie N. Armond, Kyle A. Hamer, Mette B. Gaarde, Louisiana State University, Baton Rouge, LA 70803.* We calculate High Harmonic Generation (HHG) yields in benzene and cyclohexane using time-dependent density functional theory (TDDFT). We show that by resolving the yield into contributions from individual molecular orbitals, we can adjust the tunnel-ionization step of HHG according to orbital ionization potentials and obtain better agreement with experiments. Supported by the U.S. Department of Energy.

SM3G – 25 Femtosecond Optical Kerr Gate in CS_2 Vapor and Liquid State, *Sandra Mamani[1], Sofia Arseniev[2], Andrew Goldstein[3], Robert R. Alfano[1], 1) The City College of New York, New York, NY 10031. 2) Fordham University, New York, NY 10023. 3) Colgate University, Hamilton, NY 13346.* The femtosecond optical Kerr effect (OKE) was investigated experimentally for the first time in CS_2 vapor state and compared with liquid CS_2. In CS_2 vapor the free Kerr rotation time of 1ps arises from the viscosity of air and the lack of nearby CS_2 molecules, while in liquid CS_2 the Kerr rotation time is 2ps.

SM3G – 26 Herriott Multi-pass Cell for Mid-Infrared Pulse Compression, *Elijah Athouris [1], Ronald Williams[1], Dipendra Khatri [2] Michael Chini [2], 1) Florida A&M University, Tallahassee, FL 32307, 2) University of Central Florida, Orlando FL 32816.* Few-cycle laser sources in the mid-infrared region significantly expand the possibilities for investigating ultrafast processes. Here we have designed and constructed a modified Herriot-type multi-pass cell for pulse compression of a mid-infrared laser source using a YAG crystal as the nonlinear medium. Work is ongoing to demonstrate the concept experimentally. Supported by the Department of Energy FES-RENEW program and by LaserNetUS.

SM3G – 27 Experimental and Theoretical Tuning of a Few-Femtosecond UV Pulse Formed Via Soliton Dynamics, *Chelsea Kincaid[1,2], Kirk Larsen[2] , Matt Bain[2] , Mat Britton[2], Ruaridh Forbes[2], 1) University of Central Florida, Orlando, FL 32826, 2) Linac Coherent Light Source, SLAC National Accelerator Laboratory, Menlo Park, CA 94025.* The generation of few-femtosecond, tunable UV and visible pulses via resonant dispersive wave emission in hollow-core fibers is experimentally and theoretically explored. Conversion efficiencies up to 12% are predicted across this wavelength range. This technology can scale to high repetition rates, making it an ideal source for experiments at LCLS-II. The work was supported by the U.S. Department of Energy.

SM3G – 28 High Harmonic Generation Ptychographic Imaging of Magnetic Materials, *Aaron Redd, Taylor Buckway, Richard Sandberg, Brigham Young University, Provo, UT 84604*. Magnetic materials are crucial to our modern society, from electrical motors to medical MRIs to hard disk drives. We have developed high harmonic driven tabletop extreme ultraviolet source to provide polarization control for studying the nanoscale magnetic ordering of materials with ptychographic imaging. Funded by BYU.

SM3G – 29 Investigation of Pulse Jitter in a Periodic Laser Pulse Train, *Ethan Sosnowski[1], Reeta Vyas[2], Surendra Singh[2], 1) Taylor University, Upland, IN 46989, 2) University of Arkansas, Fayetteville, AR 72701.* An optically pumped Nd:YAG laser incorporating an intracavity fast saturable absorber as a passive Q-switch was built. Stable periodic pulse train generation was achieved by varying the pump power, cavity length, and absorber location inside the cavity and dependence of pulse jitter and rise time on pump power was investigated. Supported by NSF-REU Grant #2244130.

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

Peter Delfyett, University of Central Florida, Presider

SM3G – 30 Solution-based processing of $Ge_2Sb_2Se_4Te_1$ phase change alloy using alkahest thiolamine solvent, *Daniel Wiedeman[1], Rashi Sharma[1], Anna Zachariou[1], Casey Schwarz[2], Brian Mills[3,4], Dennis Callahan[4], Parag Banerjee[1], Juejun Hu[3], Kathleen Richardson[1], 1) University of Central Florida, Orlando, FL 32816, 2) Ursinus College, Collegeville, PA 19426, 3) Massachusetts Institute of Technology, Cambridge, MA 02139, 4) The Charles Stark Draper Laboratory, Cambridge, MA 02139.* Phase change materials (PCMs) are important building blocks in solid state memory and photonic devices. Investigating compositional choices for PCMs with specific performance properties is time-consuming. Combinatorial solution-based processing of PCMs shows promise in allowing for higher throughput candidate evaluation for PCM research. $Ge_2Sb_2Se_4Te_1$ (GSST) was investigated as a target PCM of interest in this work. An alkahest solvent mixture comprising of ethanedithiol and ethylenediamine was used in this work. This work is funded by National Science Foundation, DMR-2225967, CER.

SM3G – 31 Investigation of properties of Einstein beams in the laboratory, *Tianze Ruan, Valeria Rodriguez-Fajardo, Enrique J. Galvez, Colgate University, NY, 13346.* We created Einstein beams in the laboratory using spatial light modulators. Einstein beams are formed by the deflection of light in gravitational lensing, which is proportional to 1/r. We investigated variations of Einstein beams with other deflection angles and studied their range and expansion rate. Supported by NSF grant: PHY-2011937.

SM3G – 32 Mechanically Scanned Interference Pattern Structured Illumination, *Ulises Thornock, Jackson Phippen, Dallin Durfee, Utah Valley University, Orem, UT 84058.* We have developed lensless imaging method using laser interference, capable of high-resolution microscopy without high numerical aperture optics. I will discuss the operation of our method as well as work I have done to characterize lasers for use in this project and automation and control of the interferometer. This work was supported by Utah Valley University's College of Science.

SM3G – 33 Testing Scanning Ptychography with a Helium-Neon Laser, *Sarah Yvette Loucks, Taylor Buckway, Aaron Redd, Richard Sandberg, Brigham Young University, Provo, UT 84604.* Ptychography is a lensless imaging technique that simultaneously produces absorption and phase images. It involves scanning a beam over the sample with overlapping regions and reconstructing the object from recorded diffraction patterns using a computer algorithm. Here we present simulations and results from our optical laser-based system. Funding NSF REU.

SM3G – 34 Anisotropic properties of Two-Dimensional Ferroelectric Material observed via Polarized Microscopy, *Ethan Weiche, Sudeep Puri, Rodrigo Rodriguez, Hiro Nakamura, University of Arkansas, Fayetteville, AR 72701.* We present anisotropic properties of the domains observed in the ferroelectric material SnS (tin sulfide). Cross polarization-microscopy was used to obtain the directional characteristics of its crystalline axes, while the refractive indices of materials were deduced by fitting the anisotropic contrast to a Fresnel law-based model. This research was funded by the NSF (NSF Award 2244130).

SM3G – 35 Femtosecond Optical Kerr Gate Response in Varying NaCl Concentration in Water, *Sandra Mamani,[1] Andrew Goldstein,[2] Sofia Arseniev,[3] Robert R. Alfano,[1] 1) The City College of New York, 2) Colgate University, Hamilton, NY 10031, 3) Fordham University, New York, NY 10023.* The femtosecond optical Kerr effect (OKE) was investigated experimentally for the first time in aqueous NaCl solution at different concentrations (0M to 4M). Correlation was found between the signal intensity and the concentration of the NaCl. The temporal properties of the Kerr signals were calculated for each case.

SM3G – 36 Identifying Hyperchaos in the Locomotion of *C. elegans*, *Dimitrios Tzepos, Jenny Magnes, George Nomah, Vassar College, NY, 12604.* Using the Eckmann-Ruelle algorithm, we estimated the Lyapunov spectra of the locomotion of *C.elegans* nematodes to investigate hyperchaos. In future work, we will filter out the spurious exponents from the spectrum using time inversion. This work was supported by the Vassar URSI fund.

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, Chambers Bay Ballroom

Wendell Hill, University of Maryland, Presider

SM4G – 1 Determining the Orbital Angular Momentum of a Vortex Beam Using the Strong Field Approximation, *Harrison Pasquinilli, Alex Schmoiller, Alexandra Landsman, Ohio State University, Columbus, OH 43210.* Using a Classical Trajectory Monte Carlo Simulation and a unique setup with a planewave beam perpendicular to a Laguerre-Gaussian beam, the strong field approximation is used to determine the angular momentum of the vortex beam. Funded by NSF Award number 2208040.

SM4G – 2 Robust storage of topologically protected light in warm alkali vapor, *Reese Tyra, Benny Makias, Muhammed Khan, Samir Bali, Miami University, Oxford, OH 45056.* We investigate the storage of light with different spatial profiles in warm ^{87}Rb vapor via electromagnetically induced transparency. We show that while the vortex of a Laguerre-Gaussian beam can be stored with good fidelity, the beam profile significantly broadens due to atomic diffusion. A Bessel beam's profile, though, remains preserved. We gratefully acknowledge support by the US Army Research Office.

SM4G – 3 Magnetic Spectrometer for Measuring Relativistic Electrons, *Elise Fiala, Rohan Mahnot, Smrithan Ravichandran, Wendell T. Hill III, University of Maryland, MD, 20740.* A magnetic spectrometer capable of measuring electrons born in the focus of, and ponderomotively accelerated to relativistic energies by, petawatt-class lasers has been designed, built, and calibrated. The instrument will be used to study free-electron dynamics in strong, tightly-focused laser fields.

SM4G – 4 Cleaning Coulomb explosion data via random coincidence subtraction, *Mason Clark, Daniel Rolles, Kansas State University, Manhattan, KS 66506.* Coulomb explosion imaging (CEI) is a powerful experimental method for determining the structure of gas-phase molecules. We created a model that reduces noise in CEI data. This is particularly important for incomplete coincidence channels that cannot be cleaned using momentum conservation. We model how the false coincidences look like and subtract their contribution. Supported by the NSF under Grant No. #2244539.

SM4G – 5 Nonlinear Thomson scattering in a strong laser field, *Aria Christensen, Yance Sun, Mahonri Romero, Chris Leigh, Kimberly Lindquist, Luke Robins, Michael Ware, Justin Peatross, Brigham Young University, Provo, UT, 84606.* We measured radiation from free electrons undergoing nonlinear Thomson scattering in an intense laser focus. Scattered photons for the first three harmonics were counted over much of the emission sphere, surrounding the laser focus. Inherent asymmetries in electron figure-8 motion causes the emission to vary markedly between the two sides of the figure-8.

4:30 – 4:45 pm --- Break

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Session SM4G (oral session, continued) 4:45 - 6:00 PM, Chambers Bay Ballroom

Wendell Hill, University of Maryland, Presider

SM4G – 6 Analysis of Retinal Imaging with the Design, Assembly, and Alignment of an Optical Relay System, *Glory Linebach, Benjamin Moon, Michele Rucci, Martina Poletti, Jannick P. Rolland, University of Rochester, NY, 14627.* We will first discuss the processing of high-resolution images and videos of the human retina that were captured with an adaptive optics system. Second, we will motivate how the implemented assembly and alignment of a custom optometer system will add a new stimulus-delivery capability to the retinal imaging system. This research was supported by the National Science Foundation I/UCRC Center for Freeform Optics (IIP-1822049) Research for Undergraduate Program.

SM4G – 7 Performance of Convolutional Neural Networks for Image Registration, *Levi Hancock, Yancey Sechrest, Tory Carr*, *Los Alamos National Laboratory, Los Alamos, NM 87545*. The resolution of 3D tomographic reconstructions in applications such as medical and nanoscale imaging is heavily affected by the alignment of each measured 2D projection. I will compare numerous convolutional neural network models that perform automatic projection alignment and improve tomographic reconstructions by initial training on a natural image dataset. Funding from LANL Strategic Partnership Project.

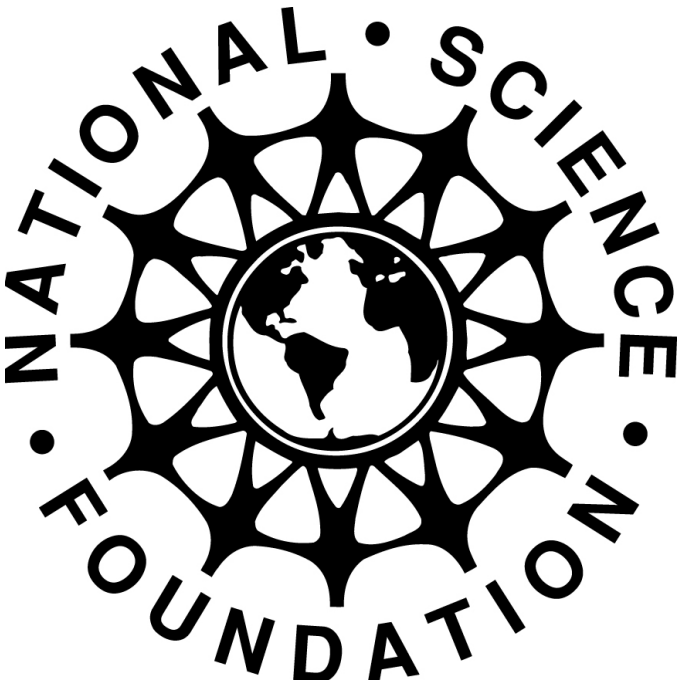
SM4G – 8 Measuring time for *B. bacteriovorus* attachment to prey, *Claire O'Connor, Allyson Sheneman, Megan A. Ferguson, Catherine M. Herne, SUNY New Paltz, New Paltz, NY, 12561.* We measure rates of attachment of predatory bacteria, *Bdellovibrio bacteriovorus,* to their prey bacteria, *Escherichia coli,* to determine the time needed for initial attachment in the predatory lifecycle. We use optical tweezers to trap and hold predator to prey bacteria. This work will aid in the development of future antibiotics.

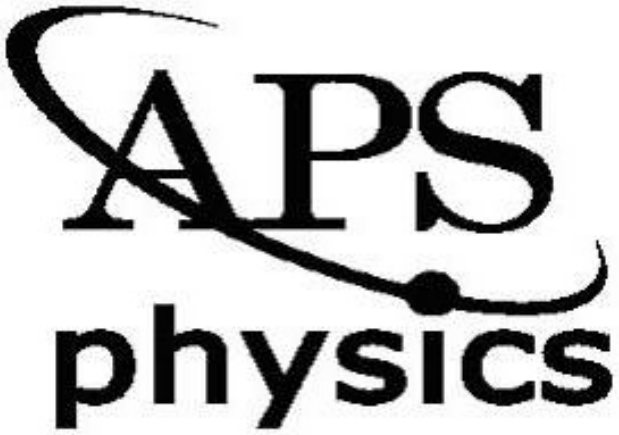
SM4G – 9 Raman and absorption spectroscopy of Brown and White Egg Shells, *Amina Shamraze[1], Rosalinda Yanez[2], Sofia Arseniev[2], Robert R. Alfano[1], 1) The City College of New York, New York, NY 10031, 2) Fordham University, New York, NY 10023.* Raman and absorption spectroscopy of Brown and White eggshells are compared. The 1086 cm^{-1} peak indicates the presence of Calcite in the shells. Brown eggshell shows absorption at 532nm laser from Protoporphyrin IX and Biliverdin giving rise to Resonant Raman Scattering.

SM4G – 10 Ultrafast molecular dynamics of 2-Bromothiophene. *Clark Bray, Noah Frese, Debadarshini Mishra, Kabir Sewrathan, Eduardo Serrata, Aaron Laforge, Nora Berrah, University of Connecticut-Storrs, CT, 06268.* Time-resolved ultrafast nuclear dynamics induced in 2-Bromothiophene are investigated through pump-probe spectroscopy, coupled with coincident Coulomb explosion imaging using COLTRIMS. With two different pump pulses (UV and IR), we examine the competition between molecular dissociation and ring-opening dynamics in this molecule. This work is being supported by the National Science Foundation under award No. 1700551.

6:30 Dinner at The Old Spaghetti Factory, 1250 Pacific Ave

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





DIVISION OF
LASER SCIENCE

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Symposium organized by Samir Bali and Harold Metcalf