SYMPOSIUM ON UNDERGRADUATE RESEARCH

(this symposium is SpE24)

Division of Laser Science of A.P.S - LS XLI - 27 October 2025 - Denver, CO

PARTICIPANTS' LUNCHEON – Mile High Ballroom 2 C - 12:00

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

POSTER SESSION – Mile High Ballroom 4 E / F - 1:00 - 3:00

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 1 Measurement of the energy of the singlet NV states, *Sean Xu, Eric Gediman, Caitlin Mary Reiter, Matt Cambria, Saroj Chand, Shimon Kolkowitz, University of California, Berkeley, CA 94720.* Despite its ubiquity as a quantum sensor, the electronic level-structure of the nitrogen vacancy center in diamond still is not fully known, specifically, the energies of the singlet states relative to the triplet states. We search for the $^3A_2$ triplet ground-state to $^1A_1$ singlet excited-state forbidden inter-combination transition between 700-850 nm. Supported by the U.S. Department of Energy.

SM3G – 2 Optical tweezer arrays of ytterbium atoms for quantum communication and simulation, *Wanda Lindquist[1], Varun Jorapur[1], Zeyu Ye[1,2], Peter Mueller[1], Michael Bishof[1], 1) Argonne National Laboratory, Lemont, IL 60439, 2) University of Chicago, Chicago, IL 60637.* We construct a 556-nm laser system which generates ultra-fast pulses for state manipulation as well as detunes laser light for the magneto-optical trap and optical pump. In addition to this, we integrate a spatial light modulator for programmable control of light phase with high speed and efficiency.

SM3G – 3 Exploring broadband comb generation using thin film lithium niobate waveguides pumped at 1030 nm and 1550 nm, *Emily Jerris[1], Carter Mashburn[1], Tsung-Han Wu[1], Ryoto Sekine[2], Luis Ledezma[2], Alireza Marandi[2], Scott Diddams[2], 1) University of Colorado, Boulder, CO 80309, 2) California Institute of Technology, Pasadena, CA 91125*. We explore the generation of optical frequency combs spanning the visible and near-infrared using thin-film lithium niobate nanophotonic waveguides pumped at different near-infrared wavelengths. This compact supercontinuum source is applicable for f-2f interferometry and dual-comb spectroscopy.

SM3G – 4 Building tunable external cavity diode laser for direct photoionization of barium atoms, *Eric Hur, Cole Wolfram, Noah Warren, Boris Blinov, University of Washington, Seattle, WA 98195.* We aim to develop a tunable 413.24266 nm extended-cavity diode laser for resonant two-photon photoionization of neutral Ba, yielding Ba^+ directly for ion trapping research. This supports isotope-selective loading in RF traps, while neutral fluorescence at 660 /667 nm verifies excitation and ionization, enabling precise trap preparation.

SM3G – 5 Breaking the dipole approximation: single-photon quantum optics with giant atoms, *Vinny Schena, Imran Mirza, Miami University, Oxford, OH 45056.* This study extends beyond the conventional quantum optics paradigm, which treats atoms as point-like relative to the wavelength of light, by investigating single-photon scattering in giant atom waveguide QED. The primary objective is to analyze novel transport phenomena in photon propagation that arise from self-interference effects in giant atoms.

SM3G – 6 Using ion trap quantum computers to design composite quantum systems: Case study in vibronic energy transfer, *Kalea Wen[1,2], Liam Jeanette[3], Jake D. Lee[2], Samwel Sekwao[4], Nicolas Sawaya[5], Norbert M. Linke[2,3], Alaina M. Green[2], 1) College of William and Mary, Williamsburg, VA 23187, 2) University of Maryland, College Park, MD 20742, 3) Duke University, Durham, NC 27708, 4) IonQ, Inc, College Park, MD 20740, 5) Azulene Labs, San Diego, CA 92121.* We have demonstrated multiple quantum subroutines to aid in design of molecular clusters on a digital trapped ion quantum computer. The energetic and vibrational excitations of a molecule are encoded using variational quantum eigensolvers (VQEs), allowing for Trotterization of the entire cluster synthesis. This may simplify a classically difficult problem.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 7 Two-photon Hong-Ou-Mandel Interference with a Fiber Coupler, *Abdulwahed Almaweri, Enrique J. Galvez, Colgate University, Hamilton, NY 13346.* Using a 50:50 fiber coupler, we measured the Hong–Ou–Mandel interference with indistinguishable photon pairs. Inserting various filters/materials introduces dispersion/birefringence, yielding shifted or double HOM dips in coincidence scans. Experiments yielded dips with high visibility.

SM3G – 8 Modifying Entanglement Quality Via Spatial Filtering, *Mitchell Pozovskiy, Carolina Guekjian, Sean J. Bentley, Adelphi University, Garden City, NY 11530.* Using spatial filtering on a polarization entanglement system, the quality of entanglement was increased by reducing which-crystal information. Using standard Bell measurements, with $S > 2$ showing non-classical behavior to a maximum possible value of 2.83, this increased S from 1.65 to 2.55 without the use of compensation crystals.

SM3G – 9 Demonstrating Quantum Computing Algorithms with Single Photons, *Daniel Faber Manning, Catherine M. Herne, SUNY New Paltz, New Paltz, NY 12561*. We send single photons programmed with two qubits through a sequence of optics that perform Grover's quantum search algorithm. We track the quantum state as it travels through the system using matrix operators representing each optical element, allowing us to predict the outcome. Measured probabilities show good correlation with expectations.

SM3G – 10 Building a Quantum Computer using Photons, *Addisu Lococo[1], Daniel Faber-Manning[2], Catherine M. Herne[2], 1) Dutchess Community College, Poughkeepsie, NY 12601, 2) SUNY New Paltz, New Paltz, NY 12561.* We show that complex quantum computing concepts can be understood by undergraduate students using accessible tools and equipment, thus expanding the quantum workforce. By manipulating single photons, we compute Grover's algorithm giving us moderate correlation.

SM3G – 11 Single-atom Lasers, *Celia Powers*, Alexandra Gospodinov*, Imran Mirza, Miami University, Oxford, OH 45056.* Lasers typically require a gain medium composed of many atoms or molecules. In this study, we explore how a single four-level atom, when strongly coupled to a single optical mode in cavity quantum electrodynamics architectures, can act like a traditional laser. **Both authors have contributed equally to this project.*

SM3G – 12 Investigating the Loop Trajectories of Single Photon in Four-Slit Interference, *Xinjian Qiu, Abdulwahed Almaweri, Enrique J. Galvez, Colgate University, Hamilton, NY 13346.* The superposition principle and Born's rule are central to quantum mechanics. Three-slit studies revealed exotic looped trajectories as additional interference paths. Their effects, though subtle, confirmed nonclassical contributions. Here, we advance this direction by investigating a four-slit configuration.

SM3G – 13 Measurement of the dc Stark-shift on the $3s^2 3p^2\ ^3P_1 \rightarrow 3s^2 3p4s\ ^3P_0$ transition in silicon, *Grant Clarno[1], Luke Phillips[1], Delaney Finley[1], Annabelle Towles[1], Alina Gearba[1], Randy Knize[1], and Jerry Sell[2], 1) U.S. Air Force Academy, Colorado Springs, CO 80840, 2) Energy and Photonics Consulting Inc., Monument, CO 80132*. Laser cooling and trapping of silicon could provide a novel avenue to manipulate individual silicon atoms. We perform dc Stark-shift spectroscopy on a silicon atomic beam at 252.4 nm to measure the differential scalar polarizability. This work allows us to address the feasibility of a Stark slower for laser cooling. This abstract has been approved for public release: distribution unlimited (USAFA-DF-2025-644).

SM3G – 14 Towards Rydberg Atom Vector Electrometry using Electromagnetically Induced Transparency (EIT) in Rb vapor, *William Torg, Robert Behary, Michael Vorobiov, Eugeniy Mikhailov, Irina Novikova, College of William and Mary, Williamsburg, VA 23187.* We measure frequencies and amplitude of two-photon EIT resonances of Stark-shifted Rydberg states in Rb vapor to determine magnitude and direction of an electric field vector. Laser polarization orientations define atomic population distribution among Rydberg Zeeman sublevels and thus uniquely determine EIT peak strengths for each E-field direction. This work was supported by U.S. DOE Contract DE-SC0024621 and DE-AC05-06OR23177, NSF award 2326736, the William and Mary 1693 Scholars Program, and the William and Mary Charles Center.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 15 Precision Mapping of the Stark Manifold, *Jordyn Strunk[1], Thomas J. Carroll[2], and Michael W. Noel[1], 1) Bryn Mawr College, Bryn Mawr, PA 19010, 2) Ursinus College, Collegeville, PA 19426.* In the Stark effect a static electric field splits degenerate angular momentum states into a nearly equally spaced ladder. In fact, each rung of the ladder contains a cluster of closely spaced total angular momentum projection states. We use optical and microwave fields to resolve these details for rubidium Rydberg atoms. Supported by the NSF.

SM3G – 16 Wafer-Bonded Thin-Films-on-Insulator for Advanced Integrated Photonics, *Shreyanka Sinha, Priyash Barya, Elizabeth Goldschmidt, University of Illinois, Urbana Champaign, IL 61801*. We introduce a room-temperature heterogeneous wafer-bonding and optimized chemical-mechanical polishing process to produce thin-films-on-insulator with low surface roughness from diverse bulk crystals. Avoiding ion implantation and high-temperature annealing preserves dopants, reduces defects, and ensures uniform thickness, enabling versatile platforms for integrated quantum and nonlinear photonic devices with broad material compatibility.

SM3G – 17 Development of Ramsey interferometer for non-invasive imaging with ^{87}Rb, *Yiyang Ding, Russell Kamback, William Miyahira, Trevor Tingle, Seth Aubin, College of William and Mary, Williamsburg, VA 23187.* We present a frequency-agile microwave source to perform precision spin operations ($\pi/2$ pulses, adiabatic rapid passage sweeps) for an ultracold atom-based Ramsey interferometer, which we plan to use for non-invasive imaging of a laser beam and an electron beam.

SM3G – 18 Doppler measurement of relative Earth-Sun motion with a laser frequency comb, *Saatwik Das[1,2], Pooja Sekhar[2], Jordan Wind[2] and Scott A. Diddams[2], 1) Peak to Peak High School, Lafayette, CO 80026, 2) University of Colorado, Boulder, CO 80309.* By tracking the frequency of a solar iron line at 1565 nm with an optical frequency comb and commercial spectrometer, we attempt to measure the relative radial velocity due to Earth's rotation during the course of a full day. This experiment serves as an accessible model of technologies used in exoplanet discovery.

SM3G – 19 Optimizing neutral atom trapping and cooling using a 2D magneto-optical trap, *Gracelynn Olinger, Emma Williams, Monte Anderson, and Jerry Sell, United States Air Force Academy, Colorado Springs, CO 80840.* Atom trap trace analysis (ATTA) captures neutral atomic xenon isotopes. We enhanced the system by adding a 2-dimensional magneto-optical trap (2D MOT) to direct more atoms into the trapping chamber. Efficiency is measured by comparing atom accumulation rate (load rate) with and without the 2D MOT.

SM3G – 20 Beam Generation for Magneto-optical Trapping Via Leaky-wave Emitter with Bottom Reflector, *Eric Barbieri and Alex Burgers, University of Michigan, Ann Arbor, MI 48109.* We design a photonic integrated circuit that uses on-chip leaky-wave emitters to generate free-space optical beams for magneto-optical trapping of cesium. By including a multilayer bottom reflector and locally tuning the quality factor of the quasi-bound wave, we produce large-area beams while enhancing diffraction efficiency for the target order.

SM3G – 21 Suppressing Current Deviations via the AC Skin Effect, *Sarah Sasinowska, William Miyahira, Seth Aubin, College of William and Mary, Williamsburg, VA 23187.* We present measurements showing the suppression of an engineered current deviation due to the AC Skin Effect at kHz frequencies in a large-scale wire trace. This suppression may be helpful in generating smooth magnetic trapping potentials for ultracold atoms in small scale atom chips at GHz frequencies. This work is supported by NSF, DTRA, and VSGC.

SM3G – 22 Quantum Entanglement-Based Magnetic Field Sensor, *Carolina Guekjian, Mitchell Pozovskiy, Sean J Bentley, Adelphi University, Garden City, NY 11530.* A magnetic field sensor was constructed using a Faraday crystal in one arm of a polarization entanglement system. By adjusting the polarizer angle in the arm not containing the Faraday crystal, coincidence measurements give information for the strength of the field, while measurements on the individual arms contain no information.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 23 Magnetic field direction detection with vortex beam via electromagnetically induced transparency (EIT) in Rubidium vapor, *Owen Rollins, Irina Novikova, Eugeniy Mikhailov, College of William and Mary, Williamsburg, VA 23187*. Amplitude and frequency of two-photon transitions between Rb spin states can provide full vector information for single-shot B-field measurements. We demonstrate sub-degree precision for azimuthal angle measurements, and a full profile of EIT amplitude with varying longitudinal angle. Supported by the Charles Center at College of William and Mary.

SM3G – 24 Rydberg State Formation in Strong-Field Ionization, *Zhan Yang, Alex Schimmoller, Alexandra Landsman, The Ohio State University, Columbus, OH 43210.* We perform classical trajectory simulations to study Rydberg state formation under strong-field ionization. Our results confirm theoretical predictions at low Keldysh parameter γ. However, at $\gamma \gtrsim 0.7$, significant deviations and a double-peak structure emerge, suggesting a breakdown of Gaussian-based models and the possible presence of new ionization dynamics.

SM3G – 25 High-Pressure Fine-Structure Mixing and Quenching Rates in Rb-He Mixtures, *Quinn Miller[1], Brian Patterson[1], Alina Gearba[1], Randy Knize[1], and Jerry Sell[2], 1) United States Air Force Academy, Colorado Springs, CO 80840, 2) Energy and Photonics Consulting Inc., Monument, CO 80132*. We perform measurements of the Rb 5P fine-structure mixing and quenching rates at various temperatures and pressures. A laser excites a Rb-He mixture at 780nm, while fluorescence photons at 795nm are counted. The measurements obtained from fitting rate equations to the data will assist in optimizing alkali lasers at higher power. This abstract has been approved for public release: distribution unlimited (USAFA-DF-2025-835).

SM3G – 26 Quantum Beats in Rb Fluorescence Signal, *Dominick J. Guadagno, Amanda Bowen, Matthew J. Wright, Adelphi University, NY 11530.* A short pulse excites Rb atoms, and fluorescence light is observed over time. Optical beating within the signal is detected. We investigate how the amplitude of the beats varies with the excitation pulse length and explore how other pulse details influence this behavior.

SM3G – 27 Extracting Spectroscopic Constants from Rovibrational Spectra: Insights into Molecular Behavior, *Zeynep Bayraktar, Hannah Stevens, Ryan Renganeschi, Kshitiz Rai, Anusha Pokharel, Burcin Bayram, Miami University, Oxford, OH 45056.* We measured the rovibrational transitions of lithium dimers using a pulsed laser. From these spectra, we extracted spectroscopic constants including the fundamental vibrational frequency, anharmonicity constant, bond strength, and potential well depth. The results were compared with theoretical predictions and values for other alkali dimers, providing benchmarks for molecular models.

SM3G – 28 Production of the negative ion of ^{232}Th for laser photodetachment spectroscopy, *Sarah R. Barnes, Charlotte M. Magnell, George Wang, Daniel Gibson, Wesley Walter, Denison University, Granville, OH 43023.* We used a SNICS II (Source of Negative Ions by Cesium Sputtering) to produce $^{232}Th^-$. The mass ratios of $^{184}WO_3^-$ were used to determine the quantity of $^{232}Th^-$ in our beam. The high electron affinity of $^{184}WO_3^-$ ensures that it will not photodetach, enabling us to conduct photodetachment of $^{232}Th^-$. This work is supported in part by NSF grant nos. 2409073 and 2110444.

SM3G – 29 The energy structure of the negative ion of ^{232}Th measured through resonant (1+1) photon detachment, *George Wang, Sarah R. Barnes, Charlotte M. Magnell, Daniel Gibson, Wesley Walter, Denison University, Granville, OH 43023*. Scanning our optical parametric oscillator over various wavelength ranges to photodetach the valence electron, we mapped out the different energy transitions associated with Th^-. Fourteen distinct photodetachment features were observed, including a strong transition near 2500 nm that has the potential for laser cooling of Th^-. This work is supported in part by NSF grant nos. 2409073 and 2110444.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 30 CW laser measurements of the structure of the negative ion of ^{232}Th through resonant (1+1) photon detachment, *Charlotte M. Magnell, Sarah R. Barnes, George Wang, Wesley Walter, Daniel Gibson, Denison University, Granville, OH 43023*. Using a continuous wave (CW) infrared OPO, we performed photodetachment spectroscopy on $^{232}Th^-$. Results include measurements of both bound and quasibound states, including a potential laser cooling transition. We plan to continue to investigate Th^- further for applications in laser cooling and information on electron correlation effects. This work is supported in part by NSF grant nos. 2409073 and 2110444.

SM3G – 31 Observing Pancharatnam Phase of Light Using Laguerre-Gauss Vortex (LGV) Beams, *Allison Avery[1], Reeta Vyas[2], Surendra Singh[2], 1) Texas State University, San Marcos, TX 78666, 2) University of Arkansas, Fayetteville, AR 72701.* Pancharatnam phase of light due to cyclic evolution of polarization was detected using plane wave interference with LGV beams. Polarization was controlled by a half-wave plate rotating between two quarter-wave plates. Spiral fringe rotation rates agree with theoretical predictions and confirm the order of on-axis phase singularity of LGV beams. Supported by NSF-REU Grant #2244130.

SM3G – 32 Measurement of the orbital angular momentum of light via diffraction grating, *Sophia Wismar, Sydney Seltzer, Mark Siemens, University of Denver, Denver, CO 80210.* The orbital angular momentum (OAM) of light has uses in optical communication and microscopy, but is manifest in light's phase and cannot be directly measured with a camera. We propose that OAM can be measured using diffraction from a grating, and demonstrate quantitatively accurate OAM measurements of a variety of modes. Supported by DU Discovery PINS Student Grants.

SM3G – 33 Generation of Lambert-Poincaré Beams. *Matthew Fumo, Enrique J. Galvez, Carlos Cardoso Isidoro, Colgate University, NY 13346.* We programmed holograms onto two spatial light modulators to generate Lambert-Poincaré beams. These beams are expected to contain all the states of polarization. Analysis of images taken of the beam front with a polarization camera confirm the expected spatially varying polarization.

SM3G – 34 Event-based high precision eye-tracking, *Nathan J. Hart, Anis Idrizovic, Michele Rucci, Jannick P. Rolland, University of Rochester, Rochester, NY 14627.* The human eye is always in motion. Consequently, precise tracking of the eye is key to further understanding human vision and enabling the next generation of visual devices. We demonstrate a fast (<1ms temporal resolution) event-based digital Dual Purkinje Image eye-tracker and report its angular resolution at various tracking ranges. Supported by NSF grant #2244031 and NIH grants R01 EY18363 and P30 EY001319.

SM3G – 35 Polarization of Nonlinear Thomson Scattering, *Michael Ballif, Yance Sun, Michael Ware, Justin Peatross, Brigham Young University, Provo, UT 84602.* We drive free electrons with an intense femtosecond laser pulse. Relativistic effects induce photon emission at the driving beam's harmonics. We characterize the polarization of these scattered photons at a variety of angles in the emission sphere. The resulting data validates mathematical predictions.

SM3G – 36 Characterizing Pulse Front Tilt with Ultra-Fast Laser Spectroscopy, *Jonathon Fisch, Emma Miller, Silvia Herzenach, Paul Arpin, California State University, Chico, CA 95929.* Angular dispersion is a phenomenon that causes light's wavefront angle to change. We commonly refer to this effect as pulse front tilt (PFT). Here we attempt to generate, observe and characterize PFT, by passing ultra-fast laser pulses through a prism, which may grant better understanding of natural ultra-fast processes. This research received support from Chico STEM Connections Collaborative.

SM3G – 37 Mid-IR Spectral Broadening and Pulse Compression using Bulk Material, *Robert Miller, Mat Leon, Michael Chini, The Ohio State University, OH 43210.* Through numerical simulations, we investigate how mid-IR pulses can be spectrally broadened and temporally compressed in both a single and multi-plate compression setup. We also built a Mach-Zehnder interferometer to characterize pulse spectrum through Fourier transform infrared spectroscopy. The work was supported by Ohio State's Summer Research Opportunities Program.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 38 Increasing peak power of mode-locked Ti:Sapphire laser pulses through cavity extension, *Zhane Yamin and Steven Cundiff, University of Michigan, Ann Arbor, MI 48168.* We optimize the bandwidth and extend the cavity length of a home-built Ti:Sapphire laser to increase the peak power of mode-locked pulses for a given average power. These high peak powers are required to observe nonlinear optical phenomena such as high harmonic generation.

SM3G – 39 Probing Near-threshold Electron Dynamics in Neon using Attosecond Transient Absorption Spectroscopy, *Margaret Price[1], Hamza B. Mekuria[1], Klaus Bartschat[2], Kathryn R. Hamilton[1], 1) University of Colorado Denver, Denver, CO 80204, 2) Drake University, Des Moines, IA 50311.* Attosecond Transient Absorption Spectroscopy (ATAS) can be used to probe electron dynamics in atoms and molecules. In this work we use an ATAS scheme consisting of time-delayed extreme ultraviolet and infrared pulses to study near-threshold electron dynamics in neon atoms. Calculations will be performed using the R-Matrix with Time-dependence code.

SM3G – 40 Laboratory analog of gravitational lensing by binary stars and black holes, *Yufeng Gu, Enrique Galvez, Colgate University, Hamilton, NY 13346.* We present a laboratory analog of gravitational lensing by binary stars and black holes. Diffraction patterns were imaged and compared with theoretical models, yielding insights into wave-optical effects for gravitational wave detection. Ongoing work extends to lensing by the black hole photon sphere. The work was supported by NSF Grant PHY-2409587.

SM3G – 41 Flat-field Correction of Talbot Phase-Contrast Images of Shock Dynamics in Foams, *McKenzie Leininger[1,2], D. S. Hodge[1,2], M. Pia Valdivia[3], C. Parisuaña[2,4,5,6], V. Bouffetier[7], K. Kurzer-Ogul[6,8], E. Galtier[4], M. Ikeya[4], D. Khaghani[4], H. J. Lee[4], A. F. T. Leong[6], B. Nagler[4], R. L. Sandberg[1,2], A. E. Gleason[2,4], P. M. Kozlowski[6], W. M. Martin[2,4,5], 1) Brigham Young University, Provo, UT 84602, 2) DOE IFE-STAR RISE-hub, Fort-Collins, CO 80523, 3) University of California San Diego, La Jolla, CA 92093, 4) SLAC National Accelerator Laboratory, Menlo Park, CA 94025, 5) Stanford University, Stanford, CA 94305, 6) Los Alamos National Laboratory, Los Alamos, NM 87545, 7) CELLS-ALBA Synchrotron Light Source, Barcelona, Spain 08290, 8) University of Rochester, Rochester, NY 14627.* We apply principal component analysis and image registration for flat-field correction of X-ray images capturing laser-driven shockwave propagation through aerogels and two-photon polymerization foams, which offer potential inertial fusion performance benefits. Our preprocessing enables visualization of hydrodynamic instability seeding and evolution, providing insights essential for capsule stability and higher yield. Supported by the DOE, IFE-STAR, SLAC, NNSA, LANL, Spanish Ministry of Science and Innovation, EUROfusion Consortium, Agencia Nacional de Investigación y Desarrollo, NSF, Hellenic Mediterranean University, and University of Bordeaux.

SM3G – 42 Advanced 3D Imaging of Polymer Foams for Inertial Fusion Energy Applications, *Levi Hancock[1,2], K. Mertes[3], A. Carr[3], X. Xia[4], C. Sweeney[3], M. Ikeya[5], Y. Chen[5], V. Esposito[5], D. Hodge[1,2], O. Hoidn[5], W. M. Martin[1,5,6], M. Mettry-Yassa[4], C. Parisuaña[1,5,6], T. Sato[5], Y. Sechrest[3], M. H. Seaberg[5], S. Song[5], A. Vong[7], A. White[5], R. L. Sandberg[1,2], A. E. Gleason[1,5], 1) DOE IFE-STAR RISE-hub, 2) Brigham Young University, Provo, UT 84602, 3) Los Alamos National Laboratory, Los Alamos, NM 87545, 4) Lawrence Livermore National Laboratory, Livermore, CA 94551, 5) SLAC National Accelerator Laboratory, Menlo Park, CA 94025, 6) Stanford University, Stanford, CA 94305, 7) Argonne National Laboratory, Lemont, IL 60439.* Ptychography uses scattered light patterns to image objects by shifting them relative to a laser in multiple positions. This research uses optical encoding to track stage movement by imaging a fluorescent point. By cross-correlating these images, the stage's traveled length is determined, effectively encoding its movement. Supported by the Mines Undergraduate Research Fellowship program.

SM3G – 43 Evaluating the Impact of Shift Variance on Modal Imaging Resolution, *Michael Ishal, Kevin Liang, Adelphi University, Garden City, NY 11530*. Via numerical simulations, we analyze whether Spatial-Mode Demultiplexing improves resolution when an imaging system is shift-variant, compared to conventional shift-invariant systems. Maximum likelihood estimations are applied to recover source parameters, allowing us to resolve the image. We compare estimation errors to the Cramér-Rao Bound for shift-invariant modal imaging. The work was funded by the Mary Klement Fellowship.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 44 Utilizing Particle Image Velocimetry to Image Fluid Flow Across Low Head Dams, "Drowning Machines", *Nathan Kallin, Rafael Volkamer-Pastor, Oliver Licht, Youssef Haddad, Martha-Elizabeth Baylor, Carleton College, Northfield, MN 55057*. To characterize the deadly currents formed beneath low head dams we built a flow chamber to image a cross-section of fluid using a high-speed camera. We built an optical system using a spatial light modulator to generate a correlation result between images, giving a vector field of the flow.

SM3G – 45 Modeling the Propagation of a Polarized Gaussian Beam After a Thick Lens, *Shadrach Christiansen, Samuel Kunzler, Michael Ware, Justin Peatross, Brigham Young University, Provo, UT 84602.* We use vector diffraction and higher-order corrections to analyze how the surface geometry of a thick lens shapes the electromagnetic field of an incident gaussian beam. We repeat the calculations with various initial polarization states.

SM3G – 46 Vector fields in a laser focus made by an off-axis parabolic mirror, *Andrew Jones, Michael Ware, Justin Peatross, Brigham Young university, 84602***.** Off-axis parabolic mirrors generate laser foci that are normally assumed to be symmetrical. However, small asymmetries might be relevant to high-sensitivity experiments. We use the Ignatovsky integral to compare on-axis and off-axis focusing using parabolic mirrors.

SM3G – 47 Fiber phase noise cancellation of dual optical tones for stable millimeter wave transfer, *Hero Trent[1], Dylan Meyer[1], Franklyn Quinlan[2], Scott Diddams[1], 1) University of Colorado, Boulder, CO 80309, 2) National Institute of Standards and Technology, Boulder, CO 80305.* We demonstrate systems and techniques for transmitting ultra-stable optical and millimeter-wave-over-fiber frequencies, mitigating thermal and mechanical perturbations that degrade stability. Fiber-based frequency transfer is crucial to advancing both fundamental physics and engineering applications.

SM3G – 48 Errors in PDH Offset Locking due to Spurious Spectral Features, *Roame A. Hildebrand, Wance Wang, Connor Goham, Alessandro Restelli, Joseph W. Britton, University of Maryland, College Park, MD 20740.* We report on a routinely underestimated source of error in Pound-Drever-Hall offset-locking: lock point shift due to the interaction between residual optical sidebands and higher-order spatial modes in Fabry-Perot cavities. We measure this deviation, find agreement with a simple model, and implement a spectrally-pure offset to mitigate this effect. This work was supported by the DEVCOM Army Research Laboratory.

SM3G – 49 Enhanced Cooling Performance Using Double Sided Passive Radiative Cooling, *Han Wang, Patricia DePalma, Samuel Jimenez, Nora Wu, Rose Sinkus, Janice Hudgings, Pomona College, Claremont, CA 91711.* We demonstrated enhanced cooling of passive radiative cooling devices, using double sided thermally emissive coatings in combination with an IR-selective mirror. We measured the effectiveness of different angles of the IR-selective mirrors and compared the performance of double-sided versus single-sided radiative coolers. Supported by NSF.

SM3G – 50 Exploring Hydrodynamic Simulation Techniques for Inertial Fusion Energy: Initial Steps Using Sedov Blast Waves and Laser Ablation Models, *Abigail Nelson and Richard L. Sandberg, Brigham Young University, Provo, UT 84602.* We performed simulations using the FLASH hydrodynamics code, focusing on strong shock waves and laser ablation relevant to inertial fusion energy. These initial models helped develop skills in modeling energy deposition and material response, laying a foundation for more advanced inertial fusion energy simulations. This research is supported by the IFE-SURE program through the Office of Science, Fusion Energy Sciences, under Award No. DE-SC 0024882: IFE-STAR issued as SLAC FWP 101126 through the IFE RISE Hub partnership.

SM3G – 51 Mapping and Correcting the End Mirror Surface of the Gravity from the Quantum Entanglement of Space-Time (GQuEST) Experiment, *Rafael Volkamer-Pastor[1], Daniel Grass[2], Erin McGee[3], Lee McCuller[2], 1) Carleton College, Northfield, MN 55057, 2) California Institute of Technology, CA 91125, 3) Stevens Institute of Technology, NJ 07030.* GQuEST's mm-thin end mirrors suffer from coating stress-induced curvature, scattering light into higher-order modes. Using a surface profiler, we mapped and then corrected for this curvature using a custom deformable mount, reducing the unwanted curvature from 30 millidiopters to 0.51 millidiopters. This work significantly drops the noise floor of GQuEST.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM3G (poster) 1:00 - 3:00 PM, Mile High Ballroom 4 E / F

Scott Diddams, University of Colorado, Boulder, Presider

SM3G – 52 Using Photoluminescence Excitation Spectroscopy on CrSBr to Probe Exciton-Phonon Coupling, *Kalp Patel, Adam Alfrey, Blake Hipsley, Cole Tait, Steven Cundiff, University of Michigan, Ann Arbor, MI 48109.* We use photoluminescence excitation spectroscopy to probe exciton-phonon interactions in CrSBr, an antiferromagnetic van der Waals material with strong optical response in bulk form. Narrow photoluminescence peaks are attributed to excitons (bound electron-hole pairs), but further investigation is required to fully clarify their origin.

SM3G – 53 Effects of Substrate Induced Biaxial Tensile Strain on the Interlayer Phonon Modes of Tungsten Diselenide, *Logan Scheiderer, Sneha Patil, Sudeep Puri, Hiro Nakamura, University of Arkansas, Fayetteville, AR 72701.* Synthesizing atomically thin layers of WSe_2 via high-temperature physical vapor deposition to impose biaxial strain via thermal expansion mismatch. We utilized Raman spectroscopy to study the change in the interlayer phonon modes. Raman spatial mapping was used to determine the spatial dependence of the amount of strain on the nanostructure.

SM3G – 54 Detect Layer Quality of 2D Materials using Color Contrast, *Huda Hashmi, Xiaohui Liu, Kyoung Pyo Lee, Xiaoqin Elaine Li, University of Texas, Austin, TX 78712*. To study novel excited states in twisted Molybdenum DiSelenide bilayers, we measure the linear absorption of a $MoSe_2$-based device with respect to an applied electric field and doping. However, to get reliable data, we need homogenous layers. Thus, we developed an image processing program that detects inhomogeneities by increasing color contrast. This work was supported by NSF MRSEC and the US Department of Energy.

SM3G – 55 Signatures of Exciton Localization from Photoluminescence Lineshapes, *Cole Tait[1], Adam Alfrey[1], Blake Hipsley[1], Julian Lüttig[2], Joshua R. Hendrickson[3], Steven T. Cundiff [1], 1) University of Michigan, Ann Arbor, MI 48109, 2) University of Ottawa, K1N 6N5 Ottawa, Canada, 3) Air Force Research Laboratory, Dayton, OH 45433.* We analyze photoluminescence from monolayer $MoSe_2$ van der Waals heterostructures by fitting spatial and spectral profiles of the exciton resonance to determine diffusion and spectral properties. Maps of the samples are made by raster scanning a diffraction-limited laser (~1μm) spot with submicron steps, giving a detailed understanding of sample heterogeneity. Supported by the Department of Energy and the Air Force Research Laboratory.

SM3G – 56 Thickness Optimization of PbS QD Films to Optimize Photoresponse of Hybrid QD–Graphene Photodetectors, *Ksenia Avrutina[1], Suraj Patel[2], Freddy Garcia[2], Oscar Vazquez-Mena[2], 1) College of William & Mary, Williamsburg, VA 23187, 2) University of California San Diego, La Jolla, CA 92093.* We prepared photodetectors consisting of colloidal PbS quantum dots (QDs) layered onto graphene. Devices were fabricated with QD films of varying thicknesses and their photoresponse was measured under incident visible and near-infrared wavelengths of light. Thicknesses which optimized photoresponse were determined. This work was supported by the National Science Foundation.

SM3G – 57 Impact of active layer uniformity and surface roughness on carrier dynamics in a thin film organic transistor, *Darren Co, Glenn Partsch, Haakon Pihlaja, Leah McCarthy, James Woo, Sarah Sucher, Taylor Venenciano, Yannai Kashtan, Gordon Stecklein, David Tanenbaum, Janice Hudgings, Pomona College, Claremont, CA 91711.* We demonstrate the use of modulated amplitude reflectance spectroscopy (MARS) to obtain high-resolution maps of carrier distribution and transport in the channel of an organic thin film transistor. MARS is used to examine the effect of surface roughness and uniformity of the semiconducting layer on carrier dynamics.

SM3G – 58 Extreme Ultraviolet Imaging with a Tabletop High Harmonic Generation Source, *David Lewis, Taylor Buckway, Hyrum Taylor, Gilbert Lopez, Richard L. Sandberg, Brigham Young University, Provo, UT 84602.* Using a table-top high-harmonic generation (HHG) source, we employ ptychography to reconstruct both the sample and beam. This method, which records overlapping diffraction patterns, allows for detailed characterization of materials by retrieving amplitude and phase information.

SM3G – 59 Tabletop Isotropic Source for Neutron Science Training, *Jarom Peterson, Richard L. Sandberg, John Ellsworth, Brigham Young University, Provo, UT 84602.* GS20 scintillator glass doped with ^{241}Am was evaluated as an affordable neutron source. The sample, showing no significant radiation damage, remained suitable for testing. Neutrons from ^{241}Am interactions were detected by the Isotropic Fission Chamber and Neutron Detector, but further analysis is required to determine a correlation with ^{241}Am interactions. This research is supported by NSF grant #2348770 and funding from the Department of Physics and Astronomy at Brigham Young University.

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM4G (oral session) 3:00 - 4:15 PM, Mile High Ballroom 3 B / C

Matthew Anderson, San Diego State University, Presider

SM4G – 1 Schlieren Imaging of Ultrasound Wave Interference Using a Pulsed LED, *Faith Poutoa, Adrian Rodriguez, Len Welstand, Mary Becker, Miche Maral, Chris Patino, Ryan Palmares, Matt Anderson, San Diego State University, CA 92115.* This study uses schlieren photography to visualize the interference patterns of ultrasonic sound waves in air. By capturing variations in a region's refractive index, direct, real-time images of wave interactions are produced. Our system enhances the understanding of acoustic phenomena and demonstrates the feasibility of low-cost schlieren setups for educational and research applications. This work is supported by a grant from the National Institute of General Medical Sciences of the National Institutes of Health: SDSU MARC 1T34GM149430.

SM4G – 2 Highly polarization-squeezed light beam for quantum metrology, *Andrew Zabinski[1], Reese Tyra[1], Imran Mirza[1], Samir Bali[1], Thad Walker[2], 1) Miami University, Oxford, OH 45056 2) University of Wisconsin, Madison, WI 53715.* We propose to create a bright polarization-squeezed light beam, with unprecedented squeezing at near-dc frequencies, by exploiting off-resonant Faraday rotation in dense atomic vapor. This may have profound implications for quantum-enhanced spin-exchange-relaxation-free (SERF) optical magnetometry. We gratefully acknowledge support by the U.S. National Science Foundation Office of Strategic Initiatives, No. 2426915.

SM4G – 3 Characterizing the Efficacy of a 2D Material Stack-and-Flip Technique with Atomic Force Microscopy Modes, *Amal Bumbia[1], Yifan Li[2], Yuwen Hu[2], Benjamin Feldman[2], 1) University of Texas, Austin, TX 78712, 2) Stanford University, Stanford, CA 94305.* To properly measure the electronic properties of helical trilayer graphene (HTG), its surface must be exposed and atomically clean. Towards this goal, we implement a polymer-to-polymer transfer method for HTG construction using PVC film. We discuss preliminary tests of this technique on twisted devices and resulting piezoresponse force microscopy measurements. Supported by the Leadership Alliance and Stanford Nano Shared Facilities (SNSF) via NSF Award ECCS-2026822.

SM4G – 4 An *Ab Initio* Study of Spinor Dynamics in One-Dimensional Few-Boson Systems, *Reagan Thompson, Tran Duong Anh-Tai, Doerte Blume, University of Oklahoma, Norman, OK 73019*. Using a configuration interaction approach, we numerically investigate a system of a few spin-1 bosons confined to a one-dimensional harmonic trap, with Zeeman sub-level splitting induced by a uniform magnetic field. By periodically modulating the trapping potential, we study the correlated dynamics in the presence of spin-preserving and spin-changing collisions. This work is supported by the Office of Undergraduate Research and Creative Activity at the University of Oklahoma and the National Science Foundation.

SM4G – 5 Age-Dependent Locomotion Dynamics in Caenorhabditis elegans in Microgravity, *Hugo Nicolas Reyes Cardozo, Olivia Trader, Jenny Magnes, Vassar College, Poughkeepsie, NY 12604.* We investigate the effects of microgravity on C. elegans locomotion using Dynamic Optical Diffraction. Largest Lyapunov Exponent and supplemental measures (frequency, mutual information, false nearest neighbors) indicate increased complexity and altered movement patterns. Microgravity-exposed worms show dynamical changes, likely from aimless neuronal hyperbranching, highlighting how altered gravity reorganizes biological behavior. Funded by the Undergraduate Research Summer Institute at Vassar College.

SM4G – 6 Mechanical Frequency Sensing Reaching the Thermomechanical Limit Beyond the Linear Regime, *Ruomu Zhang[1,2], Sofia Brown[1,2], Ravid Shaniv[1,2], Chris Reetz[1,2], Cindy Regal[1,2], 1) JILA, University of Colorado and National Institute of Standards and Technology, Boulder, CO 80309, 2) University of Colorado, Boulder, CO 80309.* We demonstrate a method to mitigate amplitude-to-frequency noise conversion in a thin-film mechanical frequency sensor operating with significant Duffing nonlinearity. Our sensor surpassed the established sensitivity limit imposed by this nonlinearity. This finding challenges the field's avoidance of increasing the amplitude of mechanical sensors into the nonlinear regime.

4:15 – 4:30 pm --- Break

SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S. - LS XLI - 27 October 2025 - Denver, CO

Session SM5G (oral session) 4:30 - 5:45 PM, Mile High Ballroom 3 B / C

Kathryn Hamilton, University of Colorado Denver, Presider

SM5G – 1 Photophoretic Trapping of Opaque Microscopic Particles in a Laser Beam, *Samuel Kunzler, Shadrach Christiansen, Michael Ware, Justin Peatross, Brigham Young University, Provo, UT 84602.* Opaque microscopic particles are trapped in mid-air with a spherically aberrated laser beam. The particles are illuminated using a secondary wavelength. Using spectral filters and correcting for chromatic aberration, we capture images of the particles' positions relative to the trapping beam's structure to better understand the trapping phenomenon.

SM5G – 2 Wait Your Turn: Modelling a Quantum Optical Turnstile with Photon Blockade, *Caden McCollum and Imran Mirza, Miami University, Oxford, OH 45056.* The efficient, predictable generation of single photons is of great importance to developments in quantum information science. In this work, we present a quantum optical system which produces antibunched light in the sub-Poissonian regime – that is, single photons – under coherent (laser) driving as a result of the photon blockade effect. Supported by Miami University Undergraduate Summer Scholars.

SM5G – 3 Broadband Non-Resonant Electro-Optic Frequency Combs based on Thin-Film Lithium Tantalate, *Yang Lan, Mengyue Xu, Di Liang, University of Michigan, Ann Arbor, MI 48109*. We demonstrate broadband electro-optic frequency combs based on in-house fabricated thin-film lithium tantalate modulators. Low $V\pi$ (voltage required for π phase shift), minimized insertion loss, and high efficiency enable over 69 comb lines with stable, tunable spacing. These results establish scalable non-resonant comb sources for advanced photonic applications. The work was supported by Toyota Research and NSF.

SM5G – 4 Computational Study of Vortex Dynamics in Bose-Einstein Condensates (BEC) in a Harmonic + Bubble Trap, *Tomoki Imura, Elisha Haber, Rachel Stromswold, Jessica Jenick, Zekai Chen, Nicholas Bigelow, University of Rochester, Rochester, NY 14627.* BEC is a mesoscopic quantum state under which particles start to behave coherently in the nano-Kelvin regimes. In our proposal, we consider a ^{87}Rb BEC in a bubble-like potential that we use to greatly extend the finite lifetime of vortices due to dissipative processes.

SM5G – 5 Ultrafast dynamics for detecting chemical composition and isotope, *Mandela Phillips, Patrick Skrodzki, Chris Martin, Ben Stein and Pamela Bowlan, Los Alamos National Laboratory, Los Alamos, NM 87545*. There are limited spectroscopic techniques that can detect both chemical form and isotope, especially for heavy elements, which has applications in forensics, safeguards and for biological imaging. We will show results aiming to do this through ultrafast time resolved spectroscopy, using the dynamics as a probe of isotope.

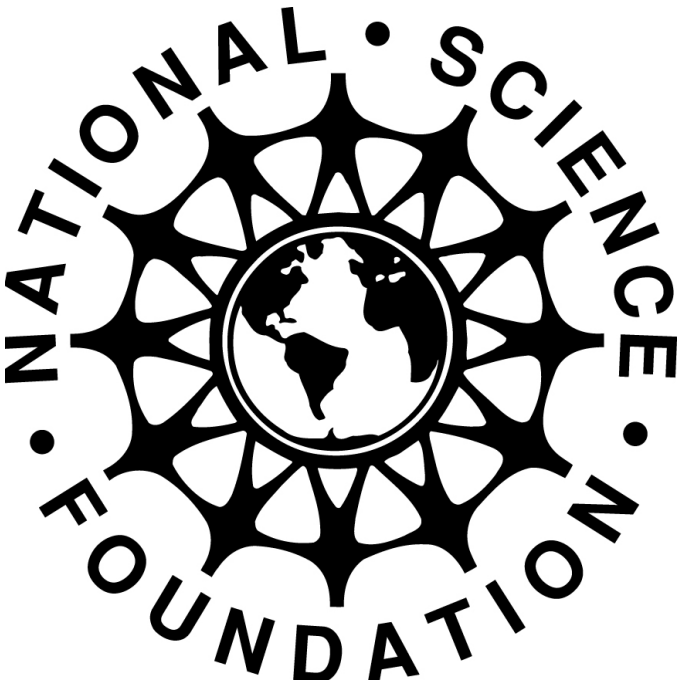
SM5G – 6 Exploring High-Order Harmonic Generation in Neon using the R-Matrix with Time-Dependence Method, *Lo Bailey Laboda[1], Kathryn R. Hamilton[1], Klaus Bartschat[2], 1) University of Colorado Denver, Denver, CO 80204, 2) Drake University, Des Moines, IA 50311.* We report preliminary results concerning high-order harmonic generation from neon atoms using the R-Matrix with time-dependence method. The harmonics are produced by a few-cycle 800 nm driving laser with a peak intensity of 2×10^{14} W/cm^2 and several pulse durations. Our results will be compared against different computational models to establish a benchmark data set. Supported by the NSF and Frontera Pathways Allocation.

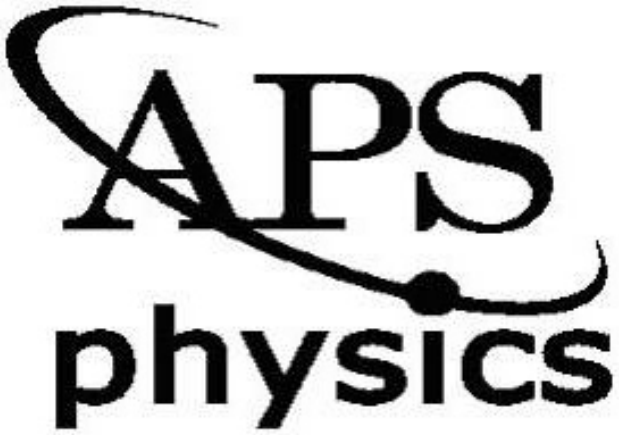
Group Photo Break 5:45 – 6:00 pm --- PLEASE assemble at the designated place!!!

6:30 Dinner: Ace Eat and Serve Restaurant

501 E 17th Ave

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





DIVISION OF
LASER SCIENCE

OPTICA
Formerly OSA

THORLABS

EAST COAST OPTICAL
TECHNOLOGIES, INC

Photonics Industries International, Inc.
390 Central Ave., Bohemia, NY 11716, USA
Tel: 631-218-2240 Fax: 631-218-2275
www.photonix.com info@photonix.com

Symposium organized by Samir Bali and Harold Metcalf