SYMPOSIUM ON UNDERGRADUATE RESEARCH

Division of Laser Science of A.P.S - LS XXXVII - 1 November 2021- Remote

[All times below are EDT]

SESSION LM3 from 11:00 to 12:45

Session LM3G: QUANTUM INFORMATION AND QUANTUM OPTICS

11:00 – 12:45 Eric Jones, Stony Brook University, Presider

LM3G – 1 Quantum state tomography of polystyrene beads, *ChanJu (Zoe) You, Enrique Galvez, Colgate University, Hamilton, NY 13346*. Using quantum state tomography, we imaged and analyzed density matrices of entangled photon pairs that were sent through polystyrene microbeads. We used photons of various Bell states and mixed states, as well as different band-pass filters to observe the resulting decoherence. This work was supported by Colgate University.

LM3G – 2 Generation of polarization entangled photons using spontaneous parametric down conversion, *Peter Menart, Gregory Lafyatis, Daniel Gauthier, The Ohio State University*, *Columbus*, *OH 43210*. Polarization entangled photons are generated and detected using single photon detectors. An inexpensive Cyclone V FPGA is employed to time photon incidences. The Cyclone V allows photons to be tagged in 5-ns bins and has an integrated hard processing system, eliminating the need for a computer.

LM3G – 3 Quantum entanglement and Bell's inequality, *Otto Nicholson[1], Jianneng Yu[2], Eric Jones[2], Harold Metcalf[2], 1) Williams College, Williamstown, MA 01267 2) Stony Brook University, Stony Brook, NY 11794.* We used spontaneous parametric down conversion (SPDC) of 405 nm pump laser light by barium borate crystals to create a Bell state to demonstrate quantum entanglement. Looking at the coincidences and calculating the Clauser, Horne, Shimony, and Holt (CHSH) value called S, we see that our results must come from entanglement.

LM3G – 4 Correlation measurements and data acquisition system using field programmable gate array, *Apoorva Bisht, Hiro Nakamura, University of Arkansas, Fayetteville, AR 72701*. We developed a photon correlation measurement setup by utilizing field programmable gate array (FPGA). FPGA will be used to enable advanced photon manipulations such as temporal multiplexing of single photons in the future. Demonstration of coherent and bunched light is demonstrated using an unmodulated and modulated laser light. Supported by Honors College Research Grant and Fui T. Chan and Kaiyuan Chen Endowed Research Scholarship.

LM3G – 5 Optics and opto-mechanics in quantum computing, *Rebeca Reyes Carrión[1,2], Jay Esposito[2], Bryan Spann[2], Sean Braxton[2], Tehseen Abidi[2], 1) University of Puerto Rico at Mayagüez, Mayagüez PR 00681 2) Honeywell Quantum Solutions, Broomfield CO 80021.* Trapped-ion quantum computing relies on laser beam alignment and stability to enable light-matter interactions ranging from atomic state preparation to quantum gate computations. Further, optical detection and measurement of the ions' fluorescence facilitates computational functions. Several techniques were implemented to optimize beam shape and intensity across the ion crystal.

LM3G – 6 Using machine learning to find the adiabatic shortcut, *Livia Guttieres[1], Murray Holland[2], Liang-Ying Chih[2], 1) the University of Chicago, Chicago, IL 60637 2) University of Colorado, Boulder, CO 80309.* We use tabular-Q reinforcement learning, to find the optimal evolution trajectory of a particle quantum-state system to a desired target state. We mitigate the issue of incoherent jumps and energy population dispersion due to the structural noise of laser cooling by evolving the system with an optimal path shortcut. Work supported by the NSF through the JILA REU.

LM3G – 7 Identification of quantum jumps in trapped Barium ions, *Akanksha Mishra, Liudmila Zhukas, Boris Blinov, Univ. of Washington, Dept. of Physics, Seattle, WA 98195.* Trapped ions are an approach to quantum computing that proposes to store qubits in the stable electronic states of trapped atomic ions. In this talk we discuss some novel methods to visualize randomly occurring quantum jumps and identify the qubit state of individual ions.

LM3G – 8 Efficient adiabatic rapid passage in the presence of noise, *Kehui Li, David Spierings, Aephraim M. Steinberg, University of Toronto, Toronto, ON M5S 1A1, Canada.* We study ARP in a two-level system under fluctuating perturbations by numerically solving the optical Bloch equations without damping, and find that population transfer is strongly affected by resonances with the noise. Further, we propose a sufficient condition for the population transfer to be above an arbitrary threshold. Supported by the Natural Sciences and Engineering Research Council of Canada.

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SESSION LM3 from 11:00 to 12:45

Session LM3H: OPTICAL SENSING & INSTRUMENTATION

11:00 - 12:45 Hong Lin, Bates College, Presider

LM3H – 1 Optimization of a laser induced fluorescence platform, *Thomas Aumer, Michael Cascio, Theodore Corcovilos, Duquesne University, PA 15282.* Laser Induced Fluorescence (LIF) complements mass spectrometry (MS) for protein identification by counting MS mass fragments when run in tandem with MS. Fluorescence allows for quantification: the amount of light re-emitted is proportional to sample concentration. Reactions are run on a polydimethylsiloxane microfluidic chip to minimize needed sample volumes.

LM3H – 2 Novel distance estimates to a variable star via photometric analysis, *Kathryn Fagan, Cian Bell, Ben McClure, David Sukow, Washington and Lee University, Lexington, VA 24450.* Via extension of photometric methods into the infrared, we generated lightcurves for a star of variable luminosity, and employed their analysis to determine its oscillation period. From formulae linking a star's metallicity to its period-luminosity relation, we derived novel distance estimates in three wavelength bands.

LM3H – 3 Numerical analysis of dynamics of vertical-cavity surface-emitting lasers subject to orthogonal and parallel optical injection, *Paul Chapman, Muhammad Abdullah, Hong Lin, Bates College, Lewiston, ME 04240.* We demonstrate that polarized optical injection can alter the occurrence of polarization switching and induce various dynamical phenomena (e. g. frequency locking, periodic oscillations) in vertical-cavity surface-emitting lasers, among which period-one dynamics can be used for photonic generation of microwaves. Supported by Bates College.

LM3H – 4 Developing a portable, smartphone-based Schlieren imaging system, *Grace N. Riermann, Keith R. Stein, Bethel University, St. Paul, MN 55112.* Schlieren imaging is a technique for visualizing fluid flows that are characterized by spatial variations in density or refractive index. Because schlieren imaging is commonly performed with expensive equipment in a lab setting, we sought cost efficiency, accessibility, and ease of fabrication by designing a portable, smartphone-based system. Supported by NSF.

LM3H – 5 Low cost laser beam stabilization and monitoring, *Sara Sayer, Disleve Kanku, Cosmin Blaga, Daniel Rolles, Kansas State University, Manhattan, KS 66506.* We report a laser beam pointing stabilization and monitoring apparatus designed for university-scale laser systems based on a low-cost RaspberryPi microcomputer, 4K CMOS cameras, and servo mirror mounts. A first prototype has been successfully deployed to continuously stabilize and monitor the beam over several hours. Work supported by NSF.

LM3H – 6 Ray optics invisibility cloaking using axicon lenses, *Ava Ianuale[1], Eric Jones[2], Harold Metcalf [2] 1) Montclair High School, Montclair NJ 07042 2) Physics and Astronomy, Stony Brook Univ., Stony Brook NY 11794.* We employed geometric optics to investigate macroscopic invisibility cloaking methods in the visible spectrum. We expanded on existing methods of cloaking to develop a model of a cloak using axicon lenses with a circular cloaking region.

LM3H – 7 Progress towards single-photon time-of-flight imaging, *Kevin Eckrosh, Matthew Brown, Markus Allgaier, Brian J. Smith, Oregon Center for Optical, Molecular and Quantum Science and Department of Physics, University of Oregon, Eugene, OR 97403.* The spatial distribution of a pulsed light source at the single-photon level is determined by coupling the field into an array of differing length fibers, which are fused into a single fiber. The output is monitored with a single-photon detector and time-tagging electronics. Results using attenuated laser pulses are presented.

LM3H – 8 Development of a high-speed measurement system for surface enhanced Raman spectroscopy, *Sarah Bense[1], Eric Katsma[1], Makayla Schmidt[1], Marit Engevik[1], Tryg Burgau[1], Nathan Lemke[1], Ariadne Bido[2], Alexandre Brolo[2], Nathan Lindquist[1], [1]Bethel University, St Paul, MN 55127 USA; [2]University of Victoria, Victoria, BC V8P 5C2, Canada.* We discuss the development of a system to collect and analyze intensity and spectral data at one million frames per second. This system is then used to study the Surface-Enhanced Raman Spectroscopy (SERS) effect for single molecules in a variety of samples. Supported by NSF.

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1:00 - 1:45 Visionary Talk by Paul Debevec

Director of Research, Creative Algorithms, Technology, Netflix, USA
"Light Fields, Light Stages and the Future of Virtual Production"

SESSION LM5 from 2:00 to 3:30

Session LM5G: OPTICAL LATTICES, ATOM INTERFEROMETRY, ATOM MAGNETOMETRY
2:00 - 3:30 Seth Aubin, College of William and Mary, Presider

LM5G – 1 An atomic magnetometer for charged particle detection based on nonlinear magneto-optical polarization rotation, *Jiahui Li, Irina Novikova, College of William and Mary, VA 23187.* We built a magnetometer using modulated light that induces polarization rotations at a strong magnetic field. We have achieved an operation range at 100mG level with 0.5nT sensitivity. Such a magnetometer is able to measure the trajectory of charged particles.

LM5G – 2 Observation of stochastic resonance and unidirectional ratcheting in an optical lattice, *Casey Scoggins, Daniel Wingert, Jordan Churi, Kefeng Jiang, Ian Dilyard, Samir Bali, Miami University, Oxford, OH 45056.* We illuminate cold atoms diffusing inside an optical lattice with a weak probe and detect directed atomic propagation perpendicular to the probe propagation. The directed propagation is resonantly enhanced by varying the photon scattering rate - a signature of stochastic resonance. Unidirectional ratcheting is achieved by varying the probe's angle of incidence on the lattice. Supported by ARO.

LM5G – 3 Frequency measurement of two optical rubidium atomic clocks, *Kristina Boecker, River Beard, John McCauley, Nathan Lemke, Bethel University, MN 55112.* We developed a system featuring two two-photon rubidium clocks and a measurement of the frequency gap between Rb-87 and Rb-85 transitions. We assessed the effectiveness of an alternating current resistive heater and magnetic field coils used to avoid frequency shifts in the atomic transitions. Work funded by the NASA Minnesota Space Grant Consortium.

LM5G – 4 Polarization-sensitive intensity correlations to probe atomic transport in an optical lattice, *Jordan Churi[1], Angela Noreck[2], and Samir Bali[1], 1) Miami University, Oxford, OH 45056 2) Cleveland State University, Cleveland OH 44115.* Following C. Jurczak, et al, Phys. Rev. Lett 77, 1727 (1996) we seek to detect polarization-sensitive intensity correlations in light scattered by atoms confined in an optical lattice. The goal is to directly measure the dwell time of atoms in wells, and the time taken to hop between adjacent wells. Work supported by NSF-REU and ARO.

LM5G – 5 Redevelopment of magneto optical trap, *Paul Russell, Mara Klebonas, and Matthew Wright, Adelphi University, NY 11350.* We have worked on rebuilding a magneto optical trap previously used by our lab group. We have set up an additional laser for the repump frequency which is locked to a sideband on the trap laser which is generated by phase modulation at 6.7 GHz. This apparatus will be used to study the control of ultracold collisions with frequency-chirped light.

LM5G – 6 Enhancing atom interferometry with quantum optimal control, *Garrett Louie and Timothy Kovachy, Northwestern University, Evanston, IL 60208.* Using numerical quantum optimal control, we have developed robust light-pulse atom optics for several techniques in large momentum transfer (LMT) atom interferometry, including multi-photon Bragg diffraction and clock interferometry. Motivations and progress on implementation will be discussed. Supported by Northwestern University.

LM5G – 7 Coaxial cable to microstrip interfacing for a microwave atom chip, *Cate Sturner, Morgan Logsdon, Sindu Shanmugadas, Seth Aubin, The College of William and Mary, Williamsburg, VA 23185.* Integrating microwaves into an atom chip enables spin specific traps for atom interferometry but requires efficient coupling of microwaves into and out of the chip. Computer simulations are used to design a broadband, low reflection, 50Ω interface from coaxial cable to microstrip via tapered co-planar waveguide. Work supported by NSF, DTRA, and VMEC/ARL-NVESD.

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SESSION LM5 from 2:00 to 3:30

Session LM5H: NOVEL IMAGING METHODS

2:00 - 3:30 Nathan Lindquist, Bethel University, Presider

LM5H – 1 Applications of electron microscopy in preparation for lensless strain imaging, *Landon Schnebly, Richard Sandberg, McKayla Townsend, Hyrum Taylor*, *Naomi Jensen, Nick Porter, Matt Wilkin, Anastasios Pateras, Anthony Rollett, Yueheng Zhang, Ross Harder, Wonsuk Cha, Barbara Frosik, Brigham Young University, Provo, UT 84601.* We seek to use x-ray coherent diffraction imaging (CDI) to study how defects in a polycrystalline metal are transmitted under strain. The constraints necessary for 3D image retrieval will be explained. Methods of electron microscopy used to analyze and prepare samples for beamline experiments will also be discussed.

LM5H – 2 Re-focusing detection in a temporal focusing microscope, *Sam Yurak, Michael E. Durst, Middlebury College, Middlebury, VT 05753.* An electrically tunable lens can be used in the detection path of a fluorescence microscope to adjust the depth in focus without changing image magnification. We synchronize this with remote axial scanning in a two-photon temporal focusing microscope to achieve wide-field optical sectioning. Supported by the NIBIB of the NIH (R15EB025585).

LM5H – 3 Using a spatial filter to reduce noise in optical diffraction, *Katie Canavan, Raffaella Zanetti, Asia Baker, Jenny Magnes, Vassar College, NY 12604*. We analyze the locomotion of *C. elegans* through laser diffraction. We use a spatial filter and an assortment of lenses to ensure the laser beam intensity is uniform. As a result, we eliminated unintended noise in the dynamic diffraction pattern of a live nematode.

LM5H – 4 Visualizing mechanical deflection with image-plane digital holographic interferometry, *Tristan Noble, Nathan Lindquist, Bethel University, St Paul, MN 55112*. We use image-plane digital holography to measure mechanical deflections of a beam under various loads. The numerical interference between holograms of a loaded and an unloaded beam directly visualizes the bending contours. We also explore phase shifting techniques to remove uncertainty in deflections of more than one wavelength. Supported by NSF.

LM5H – 5 High-resolution nonlinear pattern formation, *Mateo Murillo, Sean Bentley, Adelphi University Department of Physics, Garden City, NY 11530.* An interferometric optical system for writing arbitrary 2-D patterns on nonlinearly absorbing substrates at a resolution better than normally allowed by the Rayleigh criterion is studied. Both computer simulations and experimental verifications are performed. Details of the system along with preliminary results will be presented. This work was supported by the Horace McDonell Fellowship.

LM5H – 6 Non-linear dynamics of confined Leidenfrost drop, *Tianrui Wu[1], Jenny Magnes[2], Harold Hastings[3], 1) Duke University, Durham, NC 27708, 2) Vassar College, Poughkeepsie, NY 12604, 3) Bard College at Simon's Rock, Great Barrington, MA 01230*. We constructed and analyzed an experimental non-linear dynamical system utilizing Leidenfrost drops confined in spherical dish with video processing methods, frequency domain analysis, and recurrence methods. We found a combined stochastic relaxation process with an embedding dimension of 3 and positive Lyapunov exponents of magnitude approximately 1 / s, displaying markers of low-dimensional chaos.

LM5H – 7 Observation of coherent backscattering for detection of physical state changes, *Claire Yang[1], Eric Jones[2], Harold Metcalf[2], Martin Cohen[2], 1) Ward Melville High School, East Setauket, NY 11733, 2) Dept. of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794.* Coherent backscattering is an interference phenomenon that produces an enhanced intensity profile in the backscattering direction. We observed this effect with improved clarity from previous studies and used it in the detection of physical state changes, where the size of and distance between the scattering centers of the medium change.

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SESSION LM6 from 3:45 to 5:05

Session LM6F: TWISTED LIGHT AND ULTRAFAST LIGHT

3:45 - 5:05 Michael Durst, Middlebury College, Presider

LM6F – 1 Experimental gravitational lensing by two-body and elliptical systems, *Thao Nguyen, Enrique Galvez, Colgate University, Hamilton NY 11346*. Using a spatial light modulator, we mimic the effect of gravity and steer the light from a laser such that the phase of the light follows logarithmic dependence with its impact parameter. From symmetric lensing objects, we move onto gravitational lensing by two-body and elliptical systems with orbital angular momentum.

LM6F – 2 Generation of Laguerre-Gauss (LG) beams, *Hope Dannar[1,2], Reeta Vyas[2], and Surendra Singh[2], 1) University of Northern Colorado, Greely, CO 80639, 2) University of Arkansas, Fayetteville, AR 72701.* We describe a mode converter based on a single cylindrical lens instead of two and demonstrate its use to transform Hermite-Gauss beams from a laser into Laguerre-Gauss beams. We also describe the design of a laser cavity for generating LG beams inside the cavity. Supported by NSF Grant # 1851919.

LM6F – 3 Topological stability of stored Bessel beams in Rubidium vapor, *Scott Wenner, Jianqiao Li, Reese Tyra, Samir Bali, Miami University, Oxford, OH 45056.* We store Bessel beams in warm rubidium vapor via electromagnetically induced transparency, and show that degradation of stored information due to atomic diffusion is suppressed. For comparison, we store an "imposter Bessel" beam generated by passing a Gaussian beam through two dark rings and show that the beam profile degrades rapidly. Supported by ARO.

LM6F – 4 Characterization of femtosecond UV pulses using an autocorrelator, *Katya Mikhailova, Zane Phelps, Surjendu Bhattacharyya, Anbu Venkatachala, Daniel Rolles, Kansas State University, Manhattan, KS 66506*. The characterization of ultrafast laser pulses is essential for determining the scope and capability of ultrafast experiments. Using an autocorrelator and subsequent data analysis techniques, we developed a robust and wavelength-independent measurement of both pulse duration and chirp for sub-100 fs UV pulses. Supported by NSF & DOE.

LM6F – 5 Supercontinuum generation with tunable dispersion, *Ruben Vargas, Michael E. Durst, Middlebury College, Middlebury, VT 05753.* We numerically and experimentally investigate the effect of dispersion tuning on supercontinuum generation in a photonic crystal fiber. We tune the dispersion in a 4f grating pair pulse shaper and measure the changes to the output spectrum. We compare our numerical results using split-step Fourier method in Python to spectrometer data. Supported by the NIBIB of the NIH (R15EB025585).

LM6F – 6 Measuring the intensity of a Gaussian beam and converting an extreme ultraviolet beam polarization from linear to circular, *Kaylee Radford, Taylor Buckway, William Giforos, Richard Sandberg, Brigham Young University UT 84602.* We measured the intensity of an ultra-short pulse titanium-doped sapphire (Ti:Sapph) laser using the knife edge method. We then implemented a MAch-ZEhnder-Less for Threefold Optical Virginia spiderwort (MAZEL-TOV) setup to convert the polarization of the beam from linear to circular. This work was supported by NSF grant # 2051129.

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SESSION LM6 from 3:45 to 5:05

Session LM6G: OPTICAL SPECTROSCOPY

3:45 - 5:05 Jenny Magnes, Vassar College, Presider

LM6G – 1 Modeling mode shifts in astro-etalons for high precision spectrographic calibration. *Molly Kate Kreider[1, 2], Scott Diddams[2], Ryan Terrien[3], 1) Univ. of Richmond, Richmond, VA 23173, 2) National Institute of Standards and Technology, Boulder, CO 8035, 3) Carleton College, Northfield, MN 55057.* Ultra-stable etalons operating over a 500 nm wavelength range are used for spectrograph calibration in radial velocity exoplanet detection. We use Fresnel analysis and the transfer matrix method to model the multi-layer dielectric etalons to explain the observed wavelength-dependent mode position variations. The impact of temperature and alignment variations was studied. Supported by NIST SURF.

LM6G – 2 Infrared laser spectroscopy of lead: measuring isotope shifts in the electron affinity of Pb, *Fabrizio E. Vassallo, N. Daniel Gibson, C. Wesley Walter*, *Denison University, Granville, OH 43023*. We measured the electron affinities of the three abundant isotopes of lead using tunable laser negative ion photodetachment spectroscopy, observing *s*-wave thresholds for ground state detachment. The high precision of our experiment permitted us to resolve a discrepancy between previous studies of the isotope shifts. Supported by NSF and the William G. & Mary Ellen Bowen Research Endowment.

LM6G – 3 Experimental observation of high-speed fluctuations in surface enhanced Raman spectroscopy, *Makayla Schmidt[1], Sarah Bense[1], Marit Engevik[1], Tryg Burgau[1], Nathan Lemke[1], Ariadne Bido[2], Alexandre Brolo[2], Nathan Lindquist[1], 1) Bethel Univ., St Paul, MN 55127, 2) Univ. of Victoria, Victoria, BC V8P 5C2, Canada.* Surface-Enhanced Raman Spectroscopy (SERS) is an optical effect with single-molecule sensitivity. Because these SERS signals fluctuate at very high speeds, here we use a system that collects fluctuation data at one million frames per second. We outline various SERS samples and experimental conditions to observe these high-speed fluctuations. Supported by NSF.

LM6G – 4 Building an ultra-low frequency Raman spectroscopy system, *Mark Whitledge, Hiro Nakamura, University of Arkansas, AR 72701.* We built a Raman spectroscopy system able to detect ultra-low frequency Raman shifts using volume Bragg filters. The system, which includes a refurbished spectrometer, was calibrated using Hg lines, and its low-frequency resolution was demonstrated using sulfur. A capability to measure monolayer WSe_2 is also shown. Supported by National Science Foundation funded Research Experiences for Undergraduate program.

LM6G – 5 Determination of Potassium fine-structure mixing and quenching cross-sections in Helium and Methane buffer gas, *Quincy Zawadzky[1], Alina Gearba[1], Randy Knize[1], and Jerry Sell[2], 1) US Air Force Academy, CO 80840, 2) Energy and Photonics Consulting, Inc., CO 80132*. We implement a method to determine mixing and quenching cross sections for a combination of potassium with different buffer gases. This is accomplished using ultrafast laser excitation and time-correlated single-photon counting. The cross-sections are then determined as a function of buffer gas pressure and temperature.

LM6G – 6 Development of an oceanographic lidar to measure the vertical distribution of particles, *Jason Boynewicz, Brian Collister, Richard Zimmerman, Charles Sukenik, Victoria Hill. Old Dominion University, Norfolk, VA 23529.* We are developing an oceanographic lidar system to measure the vertical distribution of ocean particles to properly model the biogeochemical processes occurring in the upper ocean. In addition, we created models to understand how refraction by ocean surface waves impact the maximum resolution of active remote sensing. Support by NOAA and the Virginia Research Investment Fund.

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SESSION LM7 from 5:20 to 6:40

Session LM7A: OPTICS IN BIOLOGICAL SYSTEMS

5:20 - 6:40 Catherine Herne, State University of New York at New Paltz, Presider

LM7A – 1 Toward two-photon absorption spectra of long-wavelength dyes used in fluorescence-guided surgery, *Isabel M. Linhares, Michael E. Durst, Middlebury College, VT 05753.* We observe two-photon excitation of long-wavelength dyes in the near-infrared region using an optical parametric amplifier. These two-photon absorption spectra determine the optimal wavelengths for the two-photon excitation of these dyes used in fluorescence-guided surgery. Supported by the NIBIB of the NIH (R15EB025585).

LM7A – 2 Attachment force of *B. Bacteriovorus* on *E. coli* over short time scales, *Carrie Smithing, Catherine Herne, State University of New York at New Paltz, NY 12561. Bdellovibrio bacteriovorus* is a predatory bacteria being considered as an alternative to antibiotics. Using an optical tweezer setup, we attach *B. bacteriovorus* to its prey, *Escherichia coli,* and measure the attachment force over short attachment times. The force is a minimum of a few piconewtons and potentially much greater. Support provided by the Kyncl Experiential Scholarship.

LM7A – 3 Using optical trapping and stretching of biological cells to characterize cell health, *Sofia Brown[1], Sunday Ajala[2], Festus Bett[2], Aotuo Dong[2], Sacharia Albin[2], Aylin Marz[2], Makarand Deo[2] 1) The College of William and Mary, Williamsburg, VA 23185 2) Norfolk State Univ, Norfolk, VA 23504.* We performed non-contact trapping and stretching of biological cells using dual-beam optical tweezer. The extent of cell deformation was higher for higher trapping powers and varied based on the cell types. This technique is useful in cell sorting and disease identification by quantifying cytoskeletal elasticity in cells. Supported by NSF (grant 1954330) and by the Virginia Microelectronics Consortium (VMEC).

LM7A – 4 Analyzing *C. elegans* locomotion using optical microscopy, *Asia Baker, Raffaella Zanetti, Katie Canavan, Jenny Magnes, Vassar College, NY 12604.* By using optical microscopy, we can analyze the locomotion of *C. elegans*. Our team determined that the microscope requires a higher numerical aperture to resolve the nematodes. As a result of increasing the aperture, our team produced videos at a higher resolution which enhanced the tracking of the nematode's locomotion.

LM7A – 5 On-demand current pulse activation of rf monopole antenna biosensor arrays with Nitrocellulose membranes, *Sindu Shanmugadas[1], Jonathan Lundquist[2], Erdem Topsakal[2], Umit Ozgur[2], Vitaliy Avrutin[2]* 1) *The College of William & Mary, Williamsburg, VA 23185,* 2) *Virginia Commonwealth University, Richmond, VA 23284.* Continuous biosensors are rendered useless by our body in 14 days. Therefore, we propose a skin-patch with an array of RF quarter-wave monopole antenna biosensors. Combustible nitrocellulose membranes prevent early contact with the interstitial fluid. A current pulse applied to disintegrate a membrane activates a new sensor in the array. Research supported by VMEC.

LM7A – 6 Illuminating *C. elegans* locomotion with laser diffraction, *Raffaella Zanetti, Katie Canavan, Asia Baker, Jenny Magnes, Vassar College, NY 12604. C. elegans*' locomotion illuminates neuronal dynamics. Observing with high resolution laser diffraction, we recorded dynamic diffraction patterns using optics, analyzed as a pixel's time series of intensity. As indicated by chaotic markers, the sample's movement was accurately represented. Each time series is compared to nematode computer simulations, improving our understanding.

SPECIAL SESSION from 7:00 to 7:45

SpE26 – 1 *Brad Conrad,* *Director, Society of Physics Students & Sigma Pi Sigma*

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

Symposium organized by Samir Bali and Harold Metcalf