2019 Annual Fall Meeting of the APS New England Section
Warwick, Rhode Island
https://www.aps.org/meetings/meeting.cfm?name=NEF19
theoretical calculations solved via time-dependent density matrix equations with multi-photon interactions between hyperfine sublevels. The line width of 210 kHz at center and broad side bands of line width of 310 kHz. Experimental magneto-optical EIA signals match well with the N-level subsystems. The amplitude of broad EIA spectral profile with the line width of 261 kHz splits into three spectra with the narrower laser radiation is on resonance with the degenerate N-type system. However, the degeneracy is lifted by the application of B-field, as all the atoms at room temperature. We prepare resonant weak probe and strong coupling fields with a single laser using two AOMs. At zero B-field, you could not be here.  

Site Measurements

mass of 4.002602 amu. The world of work, whether or not it is academic work, is very different from the world of a student. We describe here a course which adds to a student’s education the elements needed to make the transition away from studenthood: legal issues in science, business issues in science, ethics, collaboration and organization. The modules of this course are built around technical writing, a central and crucial part of a career.
B01.00006 Study on the CNT Nanoparticles Used in Treatment for Cancer Using Bio-chemical and Computational Analysis, NUO CHENG, RICHARD KYUNG, CRG-NJ — Computational biomedical simulation with nano technology is perceived as a new approach to an alternative method for future solution of cancer research. In recent years, potential solutions in cancer treatment used nano scaled carbon nanotube complexes, since they are believed to be able to stabilize the cells affected by cancer. A free-radical chain reaction capable of propagating in space is the major oxidative reaction in biomembranes. In the light of the promising use of carbon nanotube complexes, this paper studies their thermodynamic safety and stability to inhibit the free-radical chain reaction which propagates in tissue spaces. For this purpose, we used the program Avogadro to model, and compare the resulting molecular energy of the clusters. Various types of Carbon Nanotube(CNT) derivatives were tested for their thermodynamic stabilities, which were measured through the optimized energies. The reactivity and conductivity were also measured through the dipole moments to calculate the activity level the molecule could have with other nearby molecules. Lastly, electrostatic potential maps were utilized to visualize the polarization and assess the reactivity level of each molecule.

B01.00007 Study on the Active Optical Layers in the Organic Solar Cell to Improve Electricity Using Physical and Computational Analysis, CHRIS LEE, St. Marks School, RICHARD KYUNG, Choice Research Group — Solar cell is a photovoltaic cell which produces electricity in the photoactive layer from sunlight by the photovoltaic effect. Many conductive organic polymers can be used in the photoactive layer to increase the efficiency of light absorption and charge the solar cell. In this paper, optical properties of fullerene derivatives, such as optimized energy(h/k/mol), dipole moment(debye) and electro-potential map are determined in the assessment of efficiency of the solar energy. Also variations of the functional group on the fullerenes were considered to check those dependencies on solar energy output. As electron acceptors in the photoactive layer, various types of organic compounds including PCBM, a fullerene derivative [6,6]-phenyl-C61-butyric acid methyl ester, were tested in the present organic solar cell simulations. Computational editing programs have been used in an effort to discover the optimal method and to compute the measurements of stability of the organic nanoparticles used in the solar cell. To determine optimization energy and electrical activity, an auto optimize tool was used for each fullerene derivative in this project. Also, the Universal Force Field (UFF) option was selected and applied to all fullerene derivatives modeled in this research.

B01.00008 Study on the Chelators Used in Treatment for Neurodegenerative Disease Using Bio-chemical and Computational Analysis, MIA MOON, Bergen County Academies, AMANDA KYUNG, NVRHS at Demarest — Iron homeostasis is currently emerging as a key factor in maintaining brain health and preventing disease. In several neurodegenerative diseases such as Alzheimers disease, Parkinsons disease, or macular degeneration, iron homeostasis has been disrupted and elevated levels of redox active metals were detected in the brain. In this research, computational methods employing quantum chemistry were used to model various chelator candidates for iron and other metal ion chelation therapy in the brain. The molecules were assessed for thermodynamic stability, reactivity, and polarization. For certain hydroxyquinoline chelates, moderate molecules and EDTA series were tested for their thermodynamic stabilities, which were measured through the optimized energies. The reactivity and conductivity were also measured through the dipole moments to calculate the activity level the molecule could have with other nearby molecules. Lastly, electrostatic potential maps were utilized to visualize the polarization and assess the reactivity level of each molecule. As antioxidants, hydroxyquinoline chelates showed good activity and stability. However, as multimodal agents, EDTA analogues showed less activity compared to the hydroxyquinoline chelates due to their geometrical aspects.

B01.00009 Systematic studies of MnO2/MWCNT nanocomposite for supercapacitor applications, SETH GAGNON, Central Connecticut State University, RIAN TUCCI, Southern Connecticut State University, MIKAELA SANTO, RILIND ABAZI, PETER LEMAIRE, Central Connecticut State University, ELLEN SCANLEY, CHRISTINE BROADBRIDGE, Southern Connecticut State University, RAHUL SINGHAL, Central Connecticut State University, RAHUL SINGHAL COLLABORATION — We have synthesized MnO2 multwall carbon nanotube composites (MnO2–CNT) with CNT concentrations of 1, 4, and 10 mg/ml in the reaction mixture. The performance of the synthesized nanocomposites was evaluated using X-ray diffraction pattern. The electrodes of MnO2–CNT morphologies were studied using conventional transmission electron microscopy (TEM). The electrodes of MnO2/CNT nanocomposites were prepared by coating a slurry of synthesized materials, PVDF binder, and carbon black [wt. ratio 80:10:10] onto Ni mesh. The electrodes were electrochemically characterized using cyclic voltammetry at various scan rate from 20 mV/s – 200 mV/s. The charge-discharge and cyclability studies were carried out at various current rate between 0.5A/g – 5A/g using MnO2/CNT electrodes, Pt foil, and Ag/AgCl as working, counter, and reference electrodes, respectively. The detailed results will be presented at the meeting.

B01.00010 Application of Nsutite as supercapacitors, RILIND ABAZI, PETER LEMAIRE, RAHUL SINGHAL, Central Connecticut State University — Nsutite is a naturally occurring Manganese Oxide of the composition Mn$^{2+}_{x}$$_{x}$.Mn$^{4+}_{x}$$_{x}$O$_{2x}$(OH)$_{2x}$ where x = 0.06 – 0.07. Nsutite and other naturally occurring manganese oxides are abundant and relatively cheap and so have found uses in applications such as the cathode material in dry cell batteries and in the steel industry. Naturally occurring Nsutite was ground using high energy ball mill and the powder was characterized using X-ray diffraction pattern. The electrodes of Nsutite materials were prepared by coating a slurry of Nsutite mixed with carbon black and PVDF binder in 80:10:10 wt. ratio using ethanol as solvent. The electrodes were electrochemically characterized using cyclic voltammetry, charge-discharge, and cyclability studies using MnO2/CNT electrodes, Pt foil, and Ag/AgCl as working, counter, and reference electrodes, respectively. The specific capacitance of Nsutite material was found as 10 F/g at 0.5A/g current. The detailed results will be presented at the meeting.

B01.00011 Nonlinear Optical Properties of Gold Nanostructures at Strong Laser Excitation, ZIBO WANG, MENGYAN SHEN, ZHE KAN, Univ of Mass - Lowell — This research showed positive results that the surface plasmonic effect holds at extreme femtosecond laser fluence. Hole burning experiments and measurement of optics constant at extreme intensity suggested damping factor is tripled at 10e7 J/m² fluence, which suggested a remaining 10% plasmonic enhancement efficiency at such intensities, which is explained using quantum field theories. Single pulse hole burning experiment performed in a mixture of nanorods with a broad absorption around 800 nm with a 35 fs laser with 800 nm wavelength and 6 mJ per pulse. Optic constants were obtained by measuring single pulse transmission and reflection data from a free-standing gold film that could move along a stage. Those results allow future research of creating neutron beam by irradiating gold nanostructures in deuterated materials.
**B01.00012** High spin intruder states of $^{47}$Sc and $^{48}$Sc using fusion evaporation reactions

Peter Derosa, Andrew MacGregor, Daniel Fouldsholt, Student Researcher, Peter Bender, Professor — Identifying collective states with clear n-particle-n-hole structure near closed shells can reveal deformation driving orbital characteristics. Such states, often high-spin in nature, can be populated using the fusion-evaporation reaction mechanism, extracted using gamma-ray spectroscopy techniques and compared to state-of-the-art theoretical shell model calculations. Recently, an experiment to look for intruder states in $^{47-48}$Sc was done using the $^{36}$S($^{14}$C,p) and $^{36}$S($^{14}$C,pn) reactions at 34-MeV performed at Florida State University’s John D. Fox superconducting Laboratory. The experimental setup included an array of HPGe detectors surrounding the enriched $^{36}$S as well as a Si particle detector telescope located at zero-degrees with respect to the beam axis. The telescope has allowed specific reaction residue to be correlated with observed $\gamma$-rays. We present preliminary results from the experiment.

1 This work is funded by the US Department of Energy.

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**B01.00013** Detector characterization and spectroscopy with C$^7$LYC n/gamma scintillators

Joseph Dopper, Andrew Rogers, Peter Bender, Partha Chowdhury, Michael Giles, Daniel Hoff, University of Massachusetts, Lowell, Edward Lamere, Massachusetts Institute of Technology, Christopher Morse, Lawrence Berkeley National Laboratory, Sanjanee Waniganeththi, University of Massachusetts, Lowell — Fast-neutron detection and spectroscopy is important for both basic and applied Nuclear Science. Inorganic $^7$Li-enriched Cs$_2$LiYCl$_6$:Ce (C$^7$LYC) scintillation detectors are an emerging technology that provide unprecedented (∼10%) energy resolution for fast neutrons in the few MeV range, obtained through the $^{35}$Cl(n, p) reaction. Additionally, the scintillators are sensitive to gamma rays, having an efficiency and energy resolution similar to NaI. Superior pulse-shape discrimination properties enable extremely clean identification of neutron and gamma events. Measurements using both sources and nuclear reactions generated with a 5.5-MV Van de Graaff accelerator have been carried out at UML to further explore their potential, including scattering experiments as test of their full spectroscopic potential. An overview of C$^7$LYC digital pulse-shape analysis techniques as well as timing and spectroscopy measurements will be presented.

1 This material is based upon work supported by the U.S. DOE, NNSA Stewardship Academic Alliance program Grant No. DE-NA0002932 and Office of Science, Office of Nuclear Physics under Award No. DE-FG02-94ER40848.

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**B01.00014** Studying the Population of Variable Objects in the Dark Energy Survey

Jennifer Locke, University of Pennsylvania, DARK ENERGY SURVEY COLLABORATION — It has been proven that locating variable stars such as quasars and RR Lyrae can be very helpful for observational cosmology, such as probing galaxy evolution and mapping black hole accretion. To perform these tasks, we need to locate variable stars in the Early Universe to study their evolution. The Dark Energy Survey (DES) is a large survey of the universe that aims to probe the nature of dark energy. By identifying and tracking variable stars in DES data, we can use these objects to calibrate the periodogram, a tool used to analyze the periodicity of data sets. We will present our results on the population of variable objects in DES and how they can be used to infer the properties of dark energy.

1 Thank you to Masao Sako, Rebekah Hounsell, and Pedro Bernardinelli for their mentorship, and to University Scholars for funding.

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**B01.00015** Image Fidelity of Legacy vs Modern VLA Data in the Analysis of High Redshift Quasar Morphology

Erik Carlson, Victoria Sutherland, Doug Gobell, University of Rhode Island, UNIVERSITY OF RHODE ISLAND TEAM — Utilizing legacy data from both the Very Large Array (VLA) and the upgraded Jansky VLA, we compare and contrast the snapshot imaging capabilities (time on source approximately 5 minutes or less) of both telescopes as well as using these results to set flux depth limits of the putative morphologies of high redshift quasars (z over 2.5). This analysis is performed on a sample of 374 flux limited quasars, with a minimum flux of 70 mJy in L band (1.4 GHz) found in the region of sky from 7 to 17.5 hours and 0 to 65 degrees, a region covered by the FIRST, GB 86, and SDSS surveys, giving L band, C band, and optical spectra, respectively, of all sources.

1 University of Rhode Island

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**B01.00016 Two Physics Grads: University President & Research Lab Chief**

Paul H Carr, AF Research Lab Emeritus — My friendship with Donald Paul Merrifield, SJ developed when we were taking MIT quantum mechanics courses. Before classes started, I would tell him about the theology courses I was taking at Harvard U. He would smile understandingly. Don completed his PhD in theoretical physics. We lost contact in 1961, when I left MIT to serve as a Lieutenant at the Redstone Arsenal AL. In 1962, I worked on microwave acoustics at the AF Research Lab, MA towards my PhD thesis at Brandeis U. My later research on surface acoustic waves (SAW) resulted in much smaller, lower-cost, signal processing filters used in radar and in today’s cell phones. This contributed to my promotion to a GS-15 Branch Chief. In 1995, I learned that Don had been the President of Loyola Marymount University. I was amazed that he invited me to have breakfast at his Jesuit residence there. He told me in his same friendly manner that he, after being ordained as a priest and teaching university physics, was selected as President during the student unrest of the Viet Nam War, “because no one else wanted the job.” As President, Don increased minority enrollment through scholarships and recruitment drives. Don would resonate with Pope Francis “On care for our common home” (2015) had Don not died in 2010, age 81.

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**Saturday, October 12, 2019 9:00AM - 10:24AM**

Session C01 General Physics

Knight Campus CCRI 4090 - Grant O’Rielly, University of Massachusetts, Dartmouth

9:00AM C01.00001 The first observation of an optical counterpart to a Short GRB from the Czech Republic: GRB160927A

Simon Trcka, Univ of Rhode Island — The robotic telescope D50, located at the Ondrejov Observatory in Czech Republic, routinely follows-up triggers of Gamma-Ray Bursts in order to study their optical counterparts. While the afterglows of long gamma-ray bursts are relatively bright, the optical emission of short bursts is much weaker and more difficult to detect. We present the first ever optical counterpart of a short burst detected in the Czech Republic by our robotic system.
9:12AM C01.00002 Global warming impact on low frequency sound absorption in the sea: update and possible projection. DAVID BROWNING, PETER HERSTEIN, Browning Biotech — Of the estimated 2.5 million pounds of carbon dioxide that is ejected every second into the earth's atmosphere, approximately 25% is absorbed into the ocean resulting in increasing ocean acidification. In addition to harmful effects on marine life, this acidification also impacts the principal cause of low frequency sound absorption in seawater, resulting in a decrease in low frequency sound propagation loss in the ocean. Recent data show a continuation of the steady increase in atmospheric carbon dioxide with a corresponding decrease in ocean surface pH (thereby increasing acidification) that has occurred in this century. The United Nations Climate Action Summit 2019 strongly recommends that these levels be stabilized in 12 years which would limit the decrease in low frequency absorption to 25%. The potential impact on the SONAR equation will be discussed.

9:24AM C01.00003 Effect of Gold Nanoparticle Size on Radiation Therapy Enhancement for JC cells, BINDESHWAR SAH, JING WU, MICHAEL ANTOSH, UNIVERSITY OF RHODE ISLAND — Radiation therapy is a regularly used technique for the treatment of cancer therapy. Radiation therapy aims to maximize damage in cancer cells while minimizing effects on surrounding healthy cells. Gold nanoparticles (GNPs) have shown the potential to enhance the effects of X-ray irradiation on cancer cells. The purpose of this experiment is to investigate what size of gold nanoparticles can enhance radiation therapy. We performed an in vitro experiment (JC mouse breast cancer cells) using X-rays and gold nanoparticles of size 5, 15, 30, 50 and 100 nm. Cells were treated with the same total mass of gold (0.05 g) for each size, and different radiation energies were used (100, 250 and 350 kVp). A linear mixed model was performed with the logarithm transformation of survival fraction as the response variable, experiment id as the random effect covariate, and nanoparticle size, radiation dose and energy as fixed effect covariates. The results showed that all sizes of gold nanoparticles were able to reduce cell survival, and that 50 nm nanoparticles had the strongest effect. These results demonstrate that the size of gold nanoparticles plays a key factor in radiation enhancement.

9:36AM C01.00004 The emergence and persistence of applied physics as a broad horizon, ALLAN PIERCE, Retired — Prompted by this meeting's provocative theme of "The Broad Horizon of Careers in Physics," the author first gives a historical account as to how applied physics emerged during WW II in the United States as a way for persons trained in physics to "spend one's days." The physics departments were more or less emptied out, and the faculty and graduate students went to a variety of government-sponsored labs, and there was also a huge importation of physicists from abroad. The work was heavy on physics and applied to defense problems, including radar, sonar, and of course nuclear energy. After the war, the defense-related applied physics work continued in a variety of newly created organizations, some carry-overs of those created during the war. Such became a major source of employment for physicists. Employing firms included the RAND Corporation, the Institute for Defense Analysis, MITRE, Avco, Arete, SAIC, Applied Physical Sciences, American Science and Engineering, Lincoln Laboratories, Physical Sciences Inc., Cambridge Acoustical Associates, and many others. The report will dwell on how these firms got started, who funds them, who they hire, and the types of projects they work on. The procedures of starting small businesses of this type are discussed.

9:48AM C01.00005 Educational Opportunities at Physics Unlimited, PAVEL SHIBAYEV, Physics Unlimited — As recent graduates of Princeton University, we have built from scratch a small nonprofit organization with the goal of developing long-term extracurricular learning and enrichment opportunities for high school students in physics and STEM across the globe. Expanding an annual physics competition, the original venture we founded in 2014, we now partner with several organizations and institutions of higher education in several countries through our independent 501(c)(3) nonprofit, run fully on a voluntary basis. At this point, besides plans to substantially grow our base of competitors, we have several new directions we would like to pursue in order to benefit students who statistically have less exposure to physics in high schools here in the U.S. and those who are historically underrepresented in this subject area. Our newest initiative, the Moonshot Program, is designed to teach a series of physics lessons to incarcerated learners over the course of 12 weeks, engaging them in the subject matter, and we are actively seeking volunteer instructors for this program. We have other ideas to both uncover hidden talent and bring many new people into this field. To learn more about our plans and get involved you may visit our website, http://physicsun.org

10:00AM C01.00006 The Geological Characteristics of Spacetime, KEVIN HARDING, None — The fabric of spacetime travels through the planet earth. Time inside the planet earth moves slower than the time near the planet’s surface and slower than the time in space. The visual depiction of earth sitting on a 2-dimensional fabric of spacetime is inaccurate. The earth is encased in cubes of spacetime that pass through the planets center and extends outwardly into space approaching infinity.

10:12AM C01.00007 Mirrors for Earth's Energy Rebalancing (MEER:ReflEction), YE TAO, Harvard University — Anthropogenic aerosols (AA) and greenhouse gases (GHG) co-emit into the atmosphere as peoples exercise unalienable rights in pursuit of well-being and prosperity. Airborne, AA cool the Earth almost as much as GHG warm it. This balancing act has radically increased 1C of warming, should the AA disappear along with fossil fuel burning without compensatory solar augmentation. In this scenario, knowledge of ecology would project the annihilation of already shifting and collapsing ecosystems. The inconvenient truth of cooling by AA renders the sum of incremental adaptation measures insufficient, regardless of implementation scale and speed of implementation, for halting an ongoing extinction of complex life on this planet. Here, we step back, take a holistic view of the Earth, and design a geoengineering project compatible with the laws of physics, empirical evidence of ecosystem functioning, as well as constraints in material, energy, economics, and sociopolitics. MEER:ReflEction applies aluminum-coated glass mirror arrays for solar radiation management. We find it feasible necessary to deploy the arrays on land and at sea within single-digit years to fully rebalance Earth’s energy. The cost for full deployment is comparable to the projected increase in risk to global assets by 2030 in the event of inaction. Decisive co-benefits, including a concurrent global transition to 100% solar thermal energy, make MEER:ReflEction the only plan available to Homo sapiens that optimizes its near-term survival and future prosperity as a people.

1Rowland Institute at Harvard

Saturday, October 12, 2019 10:30AM - 11:42AM –
Session D01 Atomic & Quantum Physics Knight Campus CCRI 4090 - Richard Price, Massachusetts Institute of Technology
10:30AM D01.00001 Engineering of entanglement in semiconductor nanowires. DUNG PHAM, SATHWIK BHARADWAJ, L. R. RAM-MOHAN, Worcester Polytechnic Institute — Confined geometries such as semiconductor quantum wires and quantum dots are promising candidates for fabricating quantum computing devices. When several quantum dots are in proximity, spatial correlation between electrons in the system becomes significant, and leads to spatial entanglement. Spatial entanglement values can be tuned with external parameters, and this provides a new avenue for forming quantum bits. Here we examine the entanglement properties of two electrons in quantum dots formed inside GaAs/Ga1-xAlxAs superlattice wires. We develop a fully variational formulation for calculating accurate few-electron wavefunctions in configuration space, and we use it to investigate the dependence of spatial entanglement on various geometrical parameters. Resonant behaviors associated with crossings of states are studied for the first time. We also observe the formation of electron clusters, and show that the entanglement value is a good indicator for the formation/dissolution of such clusters. Further, we show that a precise manipulation of the entanglement values is feasible with applied electric and magnetic fields.

10:42AM D01.00002 Study of Carbon Isotopic Effects in Hydrocarbon Chains. ZHE KAN, WANGYAO LI, MENGYAN SHEN, Univ of Mass - Lowell — 13C has been a reliable candidate as an isotopic tracer in various research areas and such chemical reactions, metabolic pathways, metabolite labeling. However, carbon isotope selectivity has been reported in recent hydrocarbon synthesis experiments by using the cobalt catalyzed Fischer-Tropsch method. Here, we present a theoretical study of the carbon isotopic effects in hydrocarbon chains. The theoretical methods include a Huckel-tight binding model, a configuration analysis, and quantum state perturbation theory. The electron vibrational energy in free 13C atoms differs from that in free 12C atoms and it is implemented in the Hamiltonian of each carbon atom ab-initially. Using the same amount of free 12C and 13C atoms provided as reactants, a possible configuration of mixed species bonded chains is analyzed in comparison with a configuration of the same species bonded chains. According to the calculations of these two configurations, noticeable differences in electron band structures and electron distributions are found. Moreover, the probability of converting free 12C and 13C atoms into a certain configuration of bonded chains is estimated through the methodology of quantum perturbation. The configuration involving only pure 12C chains and 13C chains is found to have the greatest possibility over any other configuration with mixed species bonded chains. It indicates that the same species tend to group together upon forming a hydrocarbon chain, this is in contradiction with a mechanism of random selection. This finding can provide a prediction and explanation of isotope selectivity in certain hydrocarbon synthesis experiments.

10:54AM D01.00003 Revisiting Lorentz Transformations with Quaternions. DOUGLAS SWEETSER, Quaternions.com — Minkowski recognized that special relativity could be viewed as a rotation in a 4D vector space. Unit quaternions (the compact Lie group SU(2)) are a double cover for 3D rotations, SO(3). It was long claimed that representing the non-compact Lorentz group SO(3, 1) with quaternions could not be done. In 2010 I found a way to generalize a rotation to do Lorentz boosts (Dr. Kharinov discovered independently):

If \( h = (\cosh(c), I, \sinh(c)) \), this does a Lorentz boost. In 2013 I noticed that for a quaternion cross product normalized to one, the scalar term is zero and the second and third terms cancel leaving the 3D rotation. Physics cannot be done with space-time alone. Space-time is a base space and an affine space, space and energy-momentum. Three rotations live in space-time, three velocities in energy-momentum. View the quaternion scalar as time and the 3-vector as space, so animations of SU(2) and SO(3, 1) can be created. SU(2) represents SU(3) at one point, specifically \( t=1 \) at the spatial origin. It grows to its maximum size at time-zero, \( t=0 \). The sphere shrinks to zero size at \( t=1 \). The animation for SO(3, 1) starts out infinitely huge, shrinks to its smallest size at \( t=0 \) matching SU(2) before expanding to infinity.

11:06AM D01.00004 High spin intruder states of \( ^{44}\text{Ca} \) and \( ^{45}\text{Ca} \) using fusion evaporation reactions. ANDREW MACGREGOR, PETER DEROSA, DAN FOULDS-HOLT, PETER BENDER, Univ of Mass - Lowell — Identifying collective states with clear n-particle-n-hole structure near closed shells can reveal deformation driving orbital characteristics. Such states, often high-spin in nature, can be populated using the fusion-evaporation reaction mechanism, extracted using gamma-ray spectroscopy techniques and compared to state-of-the-art theoretical shell model calculations. Recently, an experiment to look for intruder states \( ^{44}\text{Ca} \) was done using the \( ^{36}\text{S}(^{14}\text{C},p) \) and \( ^{36}\text{S}(^{14}\text{C},pn) \) reactions at 34-MeV performed at Florida State University’s John D. Fox superconducting Laboratory. The experimental setup included an array of HPGe detectors surrounding the enriched \( ^{36}\text{S} \) as well as a Si particle detector telescope located at zero-degrees with respect to the beam axis. The telescope has allowed specific reaction residue to be correlated with observed \( \gamma \)-rays. We present preliminary results from the experiment.

1 This research was funded by the Department of Energy

11:18AM D01.00005 Application of Artificial Intelligence in Tuning Femtosecond Laser Systems. VLAD GACIU, University of Massachusetts Lowell — This work describes a design used to automate a tunable laser system to correctly and autonomously reach user requested peak wavelengths and spectral widths. This laser system is comprised of a tunable mode-locked femtosecond laser. The system is tunable by mechanical motors programmable with software. Varying slit width and slit position shift the peak in opposite directions, which allows a secondary tuning of the spectral width, which is only dependent on the slit width. The automation displays a level of artificial intelligence where the program acquires data autonomously and applies machine learning techniques to predict and understand a suitable slit position and slit width for any desired output. This design does not require an experienced user and can significantly save time. Future developments with the current design can be made to automate larger and more complicated tunable laser systems. This is a new area of research which can help pave the way for more advanced use in the ultrafast laser industry.

11:30AM D01.00006 The Double Slit Experiment Viewed as an Unsolved Math Problem. JEFFREY BOYD2, Retired — If the double slit experiment were an unsolved math problem, an applied mathematician might devise a fortuitous plan of attack. This APS member is such a mathematician. Searching for ignored peculiarities, we discover empirical evidence that sometimes particles follow zero energy waves backwards. This is counterintuitive, and we will postpone addressing how that is possible. What if there were such waves involved in a double slit experiment. Every point on the target screen would emanate waves, they would go through the two slits and interfere at the particle gun. At random, and based on the strength of the interference, a particle would choose one particular wave to follow backwards. After that the mechanism would become deterministic, with no further wave interference. The particle would follow its wave with a probability of one and make a dot at that point where its wave originated. It is easily proved that this would reproduce the mathematics and the pattern on the target screen. If we take a wave described by Feynman, and turn it around, we would have a model for the wave we seek. It is easily shown that the amplitudes of these waves form a linear vector Hilbert space. It is easily shown that these could be Schroedinger waves. Schroedinger waves have zero energy; they carry probability amplitudes instead. Three new axioms arise: 1. Wave function collapse occurs before measurement, 2. there is no wave particle duality; 3. Waves and particles travel in opposite directions.

1 NA
2 This is being considered by the Quarterly Journal of Applied Mathematics.