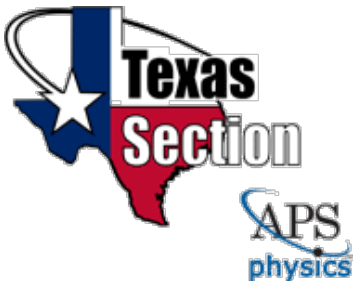
2023 Joint Spring Meeting: TSAAPT/TSAPS/SPS Zone 13

Texas A&M University-Commerce
Mar 23-25, 2023 · Commerce, TX



Welcome!

The joint meeting of the Texas Section of the American Association of Physics Teachers (TSAAPT), the Texas Section of the American Physics Society (TSAPS) and Zone 13 of the Society of Physics Students (SPS), brings together a diverse group of physicists - researchers and teachers, students and faculty, college and high school - to show off their research, learn from each other and discuss how to enrich physics for all.

The program includes plenary talks, sessions and workshops devoted to research, teaching and the interaction between physics and society.

High school physics teachers will receive professional development certificates for sessions and workshops they attend.

A quiet room is available if you need to take time out from the hustle and bustle of the the conference.

Two meeting rooms (273 and 274) are provided for impromptu meetings.

Looking forward to seeing you all in Commerce, TX!

William G. Newton,

President of the Texas Section of the American Association of Physics Teachers, on behalf of the Local Organizing Committee.

Schedule: Joint Spring Meeting of the TSAAPT,TSAPS and Zone 13 of SPS				
All sessions on the 2nd floor of the Sam Rayburn Student Center except those marked "Science Building". The Science Building is opposite the Student Center.				
Use Parking Lot 19				
Quiet Room: Vision	**Meeting spaces: Meeting rooms 273 and 274**			
THURSDAY				
Registration	5-7pm	**Science Building Foyer**		
TSAAPT Board meeting	7-8:30pm	**Science Building 146**		
TSAPS Board meeting	7-8:30pm	**Science Building 135**		
Joint TSAAPT/TSAPS board meeting	8:30-9pm	**Science Building 135**		
SPS activities, food and drinks	7-9pm	**Meet in Science Building Foyer**		
FRIDAY				
Registration/Breakfast	8am-10am	**Outside Conference A-C**		
Plenary I	8:45am-10:15am	Welcome Claudia Ratti, Larry May **Conference A-C**		
Coffee - outside Conference A-C				
Parallel I	10:45am-12pm	Physics Education Research/Physics Education I **Pride**	Astrophysics and Space Science I **Traditions**	Nuclear and Particle Physics I **Innovations A**
10:45-10:55am		Calvin Berggren	Carl Ziegler	Diana Carrasco-Rojas
10:57-11:07am		Tunde Kushimo	Joshua Ange	Courtnee Staine
11:09-11:19am		Beth Thacker	Saif Ali	Alejandro Florez
11:21-11:31am		Walter L. Trikosko	Sharon Felix	Jose Modesto Alanis III
11:33-11:43am		Arno Vigen	Joshua Schussler	Sebastian Regener
11:45-11:55am			Tamanjyot	Rebecca Preston
Lunch/Plenary II	12-1:15 pm	Katerina Chatziioannou **Conference A-C**		
TSAAPT Business meeting	1:15pm-1:45pm	**Meeting room 273**		
TSAPS Business meeting	1:15pm-1:45pm	**Meeting room 274**		
Poster set-up	1:15pm-1:45pm	**Conference A-C**		
Parallel II	1:45pm-3:15pm	Physics Education Research/Physics Education II **Pride**	Astrophysics and Space Science II **Traditions**	SPS workshop: Professional Skills and Negotiations **Innovations A**
1:45-1:55pm		Thomas O'Kuma	Michael Kesden	Barbara Szczerbinska
1:57-2:07pm		Jess Dowdy	Zorayda Martinez	
2:09-2:19pm		Greg Morrison	Avijit Bera	
2:21-2:31pm		Timothy Renfro	Lindsay King	
2:33-2:43pm		James C. Espinosa	Caleb Melton	
2:45-2:55pm				
Coffee - outside Conference A-C				
Parallel III	3:45pm-5:30pm	Biophysics and Medical Physics I **Pride**	Atomic, Molecular and Optical/Condensed Matter **Traditions**	SPS talks **Innovations A**
3:45-3:55pm		Dustin Johnson	Sumit Khadka	Matthew Oliver
3:57-4:07pm		Cody Larsen	Anil Chourasia	Jinung (Michael) Kim
4:09-4:19pm		Asiye Asaadzade	Ibikunle Ojo	Cody Morgan
4:21-4:31pm		Melody Siroosian	Jared Pohlmann	Nathan Moore
4:33-4:43pm		Melodee Seifi	Christopher B. Marble	Alyssa Auten
4:45-4:55pm			Austen Adams	Hannah Gex
4:57-5:07pm			Hoa H. Nguyen	
5:09-5:19pm				
Workshops I	3:45pm-5:45 pm	Toni Sauncy **Science Building 135**	Regina Berrera **Science Building 146**	Larry Isenhower **Science Building** 107
Poster	5:30pm-6:30pm	**Conference A-C**		
Banquet	6:30pm-8:30pm	**Conference A-C**		
After dinner speaker	7:30pm-8:15pm	Noah Finkestein **Conference A-C**		

SATURDAY				
Registration/Breakfast	8am-10am	**Outside Conference A-C**		
Plenary III	8:45am-10:30am	Michael Marder Dawson Lang **Conference A-C**		
Coffee - outside Conference A-C				
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11:36-11:46am		Dipankar Sen	Simba Wobogo	
11:48-11:58am			Brad Brown	
12:00-12:10pm			Brian Reid	
12:12-12:22pm				
Workshop II	11am-12:30pm	Thomas O'Kuma **Science Building 135**	Mary Urquhart - Eclipse **Science Building 146**	Eleanor Close **Science Building 107**
Lunch/Student and TSAAPT awards/Plenary IV (with COSINE TX)	12:45pm-1:45pm	Pam Gossin **Conference A-C**		
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Friday 24 March 2023

Plenary Session I (8:45am-10:15am)

24 March
8:50am-9:30am
Conference A–C

From Heavy-Ion to Neutron Star Collisions

Claudia Ratti, Ph.D.
University of Houston

I will review our current knowledge of the phase diagram of strongly interacting matter, combining information from first-principles lattice Quantum-Chromodynamics (QCD) simulations, experimental heavy-ion measurements and astrophysical observations of neutron stars and their mergers. The field of heavy-ion collisions has led to impressive insights into many aspects of QCD matter such as its equation of state, its perfect fluidity and its rich phase structure. In addition, it provides the possibility of impacting other fields such as nuclear structure, relativistic fluid dynamics, nuclear astrophysics and gravitational wave physics. These exciting results are matched by an unprecedented precision in lattice QCD simulations, due to both algorithmic development and increase in computational power. I will focus on my recent contributions, to address the following open questions in the field: (1) Is there a critical point on the phase diagram of strongly interacting matter, separating crossover from first-order phase transition? (2) What are the degrees of freedom that populate the phases of matter in the different regimes of temperatures/densities? (3) Can we learn something about the phases of dense matter from gravitational waves and neutron star properties? I will also discuss ongoing work and future plans to continue investigating these and related questions in the field of hot and dense matter.

Lessons Learned from the Texas Research Expanding Nuclear Diversity (TREND) program

24 Mar
9:35am–10:15am
Conference A–C

Larry W. May[1], Jorge Lopez[2], Justin Mabiala[3], Lauren A. McIntosh[1], Jorge Munoz[2], Toni Sauncy[4], and Sherry J. Yennello[1]

[1]Texas A&M University, [2]University of Texas at El Paso, [3]Prairie View A&M University, [4]Texas Lutheran University

A new workforce development program in Texas is now in its second year with the initial cohort of students. Sponsored by the DOE Office of Science-Nuclear Physics, seven undergraduate students from four Minority-Serving Institutions (Texas A&M University, Prairie View A&M University, Texas Lutheran University and the University of Texas at El Paso) began working remotely with PIs from the Cyclotron Institute at Texas A&M University (TAMU) with the support of local mentors during the Spring 2022 semester. They spent summer 2022 continuing these research projects in person at TAMU. Upon return to their respective home institutions, the students continued working on their research projects remotely. Several TREND setters have presented their work at national conferences. The program supports students in research for up to two years and as we enter the second year of that period, lessons learned from the start of the program and next steps will be discussed.

Parallel Session Ia: Physics Education Research/Physics Education I

Solving Kinematics Problems Using Kinematic Graphs

24 Mar
10:45am–10:55am
Pride

Calvin Berggren

Texas Lutheran University

Kinematic graphs is a popular topic for algebra-based physics, but rarely are the graphs used to solve problems. This talk will communicate experience I have gained in how to teach students to solve kinematics problems directly from the graphs.

Investigating students' strengths and difficulties in Quantum Computing

24 Mar
10:57am–11:07am
Pride

Tunde Kushimo[1] and Beth Thacker[2]
[1]Southern Methodist University and [2]Texas Tech University

Quantum Computing is an exciting field that draws from information theory, computer science, mathematics, and quantum physics to process information in fundamentally new ways. There is an ongoing race to develop practical/reliable quantum computers and increase the quantum workforce. This needs to be accompanied by the development of quantum computing programs, courses and curricula coupled with the development and adoption of evidence-based materials and pedagogies to support the education of the next generation of quantum information scientists and workforce. At our university, we introduced an introductory course in Quantum Computing to undergraduate students and conducted a case study to investigate the strengths and difficulties of these students in quantum computing after taking the introductory course. Our goal is to contribute to the improvement of quantum computing education while understanding the topics that the students find easy to comprehend and topics that are difficult to comprehend. This investigation is essential to help train the next generation of quantum scientists and researchers because it gives information and direction to quantum computing education. We report on the results of these research and our initial work to development evidence-based materials.

Assessing Thinking Skills in Free-response Exam Problems: Pandemic Online and In-person

24 Mar
11:09am–11:19am
Pride

Beth Thacker, Fatema Al-Salmani, and Jordan Johnson
Texas Tech University

We present an analysis of students' thinking skills as evidenced in free-response exam problems during the Covid-19 pandemic. We compare two inquiry-based, laboratory-based Classical Mechanics courses, one taught online and one taught in-person during the pandemic and two inquiry-based, laboratory-based Electricity and Magnetism courses, one taught online and the other in-person during the pandemic. We use a rubric that was previously developed based on Bloom's taxonomy (revised version) to compare thinking skills of students in classes taught by different pedagogies [9]. We discuss the method and analysis, present results and interpretations. No significant differences were found in thinking skills between students in the online and in-person pandemic Classical Mechanics courses. However, we did see a difference in the thinking skills between the online and in-person pandemic E&M courses as the semester progressed.

24 Mar
11:21am–11:31am
Pride

When the Experiment Fails

Walter L. Trikosko and Joseph A. Musser

Stephen F. Austin State University

Imagine this scenario: We wish to demonstrate the inverse square law to our students by showing that the radiation flux from a point source obeys the inverse square law. To do this we record the counts of a Sr-90, beta source using a Geiger-Mueller counter at ten distances between the source and the window of the G-M tube, with each run for the same time. We now graph COUNTS vs expecting the plot to be linear but it clearly is not. What went wrong?

24 Mar
11:33am–11:43am
Pride

Teaching the Fine Structure Constant (α) Dimensionless as (Distance / Equilibrium Distance)^V Position-In-Field Scaling

Arno Vigen

Independent researcher

The Fine Structure Constant (α) occurs in hundreds of physics equations, but wrongly it gets taught as "dimensionless" and "independent of the system of units". Dimensionless gets replaced by (distance/equilibriumdistance)$^{\mathrm{V}}$ with the basic 1e:1p equilibrium and Bohr-H (a_0). Instead of being independent of the system, α applies better as the (1/2) version of general scaling by $(d/a0)^V$, $(d/a0)^{(V/W)}$, or $(d/a0)^{((V-W)/W)}$. This provides insight into understanding many advanced physics equations. This includes elementary particle mass-values, by the square root scaled to $(d/a0)^{(3/4)}$ versus their mass-units.

Parallel Session Ib: Astrophysics and Space Science I

SOAR TESS survey: Thousands of High-resolution Images of Planet Hosting Stars

24 Mar
10:45am–10:55am
Traditions

Carl Ziegler[1] and Andrei Tokovinin[2]
[1]Stephen F. Austin State University, [2]Cerro Tololo Inter-American Observatory (CTIO)

The TESS mission has been enormously successful, finding over 6000 transiting exoplanet candidates across the entire sky. Confirming and characterizing these candidate planets requires ground based observations. High-resolution instruments from the ground probe far closer to the host star then TESS can resolve, revealing the true architecture of the stellar system and its environment. The SOAR TESS survey has observed over 3000 Southern stars, detecting 700 sub-arcsecond companions. These results have been assisted in validating the majority of confirmed TESS planets. In addition, this large dataset suggests that close-in binary stars are not amenable to the formation or survival of planetary systems. In stars at separations less than approximately twice size of Neptune's orbit (50 AU or less), we find greater than 90% reduction in detected planet candidates. As about a quarter of solar type stars are in such systems, this has a significant impact on our estimates of the planet population within our galaxy.

Cosmic Microwave Background Delensing and The Hubble Tension

24 Mar
10:57am–11:07am
Traditions

Joshua Ange and Joel Meyers
Southern Methodist University

The Hubble Tension is a well-known problem in modern cosmology that refers to the disagreement in measurements of the Hubble constant H_0 as found through the cosmological distance ladder and values inferred from early universe observations, assuming the LCDM model. It has been shown that reversing the effects of gravitational lensing on Cosmic Microwave Background (CMB) maps produces sharper acoustic peaks and allows for tighter constraints on cosmological parameters. We investigate the efficacy of CMB delensing for improving the constraints on parameters used in extensions of the LCDM model that are aimed at resolving the Hubble Tension (such as varying fundamental constants, contributions from Early Dark Energy, and self-interacting dark radiation). We use Fisher forecasting to predict the expected constraints with and without this delensing procedure. We demonstrate that CMB delensing improves constraints on the Hubble constant in the range of 20-30% for some models and will significantly improve constraints on parameters across the board with future data.

24 Mar
11:09am–11:19am
Traditions

Gravitational lensing signatures in gravitational waves

Saif Ali
University of Texas at Dallas

Gravitational waves (GWs) can be gravitationally lensed in a way that is complementary to electromagnetic (EM) waves. In contrast to the lensing of EM waves, the low frequency and coherent nature of GWs make them sensitive to wave-optics effects. These effects lead to frequency-dependent modulations of the GWs. We begin with a brief review of GWs lensing formalism and how lensed GWs are modeled, for the axisymmetric lens, using model-dependent lens parameters. We asses the systematic error in the lens parameters associated with uncertainty in the lens model and circumvent them by using model-independent image parameters. We understand the invalidity of geometrical-optics approximation in the case of an elliptical lens model and quantify the breakdown by employing quasi-geometrical optics approximation. With the increasing sensitivity of the GW detectors, the possibility of observing lensing signatures in GWs will increase drastically. The detection of these lensing signatures will allow us to probe fundamental physics and can lead to several new scientific studies.

24 Mar
11:21am–11:31am
Traditions

Exploring a Merger Scenario for the High-Redshift Cluster JKCS041

Sharon Felix
UT Dallas

In this talk, we present our investigation of the JKCS041 system, observed at a very early stage of its life cycle at z=1.8. This massive system at high redshift provides a unique opportunity to understand structure formation, including non-spherical and non-relaxed states of clusters. One remarkable observable of the system is the particularly low SZ signal compared to others of similar mass. We used the hydrodynamic simulation code GAMER-2 to model this system as a cluster merger and explain the curious features it exhibits. We present our study on how the gas distribution evolves during a merger event and the corresponding changes in the SZ peak values. Our simulations reproduce the decrease in SZ signals after pericenter passage seen in previous studies. We also used X-ray temperature and gas mass derived from the X-ray observations to constrain the cluster merger parameter space. Additionally, we did gravitational lensing analysis of our best fit configuration and found it consistent with that of the recent observational studies. Our results suggest that the system has likely undergone a major merger, accounting for the offset between SZ and X-ray peaks as well as the low SZ signal.

Comprehensive Bayesian modelling of tidal circularization in open cluster binaries part I: M 35, NGC 6819, and NGC 188

24 Mar
11:33am–11:43am
Traditions

Joshua Schussler and Kaloyan Penev
University of Texas at Dallas

Tidal dissipation is known to circularize binary star orbits but is not currently well understood. We carried out a study aimed at increasing our understanding of the phenomenon. Previous measurements of tidal dissipation properties have sometimes failed to account for important physical elements or certain observational uncertainties; we made a point of incorporating such factors. As a result, we were able to derive high-precision results for short-period binaries of Sun-like stars. We constrain main sequence tidal quality factor to $5.7 < \log_{10} Q' < 6$ for tidal periods between 3 and 7.5 d, while pre-main sequence stars we probed returned $Q' < 4 \times 10^4$. We also investigated the possibility of frequency dependence and found that for the tidal periods we probed such a dependence must be sub-linear for main sequence stars. Also, by finding tidal dissipation on a system-by-system basis and more fully accounting for stellar evolution, we have reduced the tension that previous studies found for the circularization of the clusters we investigated.

Tidal disruption events by spinning supermassive black holes

24 Mar
11:45am–11:55am
Traditions

Tamanjyot and Michael Kesden
The University of Texas at Dallas

When a star gets too close to a supermassive black hole (SMBH), the tidal forces can overpower its self-gravity, causing a tidal disruption event (TDE). As the black hole accretes some of the stellar debris, an electromagnetic flare may occur, lasting for years after the initial event. The inclination of these events relative to the SMBH spin has several observational implications, such as relativistic precession of the debris causing a delay in accretion, bolometric radiative efficiency, and observable quasi-periodic oscillations. By calculating inclination distributions based on SMBH mass and spin, we demonstrate the importance of inclinations and how these distributions arise from the interplay between tidal forces, direct capture by the event horizon, and two-body scattering. We find that the distributions are mostly prograde and integrate them to determine the total TDE rates for SMBH mass and spin. Our results have significant implications for TDEs' observational properties and the dynamics of galactic nuclei.

Parallel Session Ic: Nuclear and Particle Physics I

24 Mar
10:45am-10:55am
Traditions

Search for states in ^{23}Na above the proton threshold

Diana Carrasco-Rojas[1], Philip Adsley[2], Jorge Lopez[1], and Matthew Williams[3]
[1]The University of Texas at El Paso, [2]Texas A&M University, and [3]TRIUMF

Globular clusters are dense groups of stars which exist near the galactic plane. Understanding their history and evolution sheds light on the history and evolution of galaxies. The presently observed stars contain elements resulting from unknown polluting sites. Identifying those sites requires improved knowledge of nuclear reaction rates. One important rate is the ^{22}Ne(p, γ) reaction. There are several unmeasured resonances lying just above the proton threshold for this reaction, and although many studies have been conducted, resonances at Ecm = 68 and 100 keV (8894 and 8862 keV excited states) have not yet been confirmed. For this experiment, we performed a new high-resolution study where a magnetic spectrograph was used to search for states above the proton threshold in ^{23}Na via the ^{23}Na(p,p$'$)^{23}Na reaction, using this reaction due to its low selectivity to the structure of the excited states. Investigation into the existence of these states in the existing data was performed. Results, which point towards the non-existence of states at Ex = 8894 and 8862 keV, will be shown.

24 Mar
10:57am-11:07am
Innovations A

Neutrino Oscillation Sensitivity Studies: Impact of Magnetizing The DUNE Far Detectors

Courtnee Staine and Dr. Daniel Cherdack
University of Houston

Dune is a next-generation long-baseline neutrino oscillation experiment that aims to measure the neutrino Mass Hierarchy and search for CP-Violation in the lepton sector. These measurements will use four Far Detectors (FDs) to determine the energy and flavor of interacting neutrinos. Sensitivity to the MH and CPV rely on comparisons of flavor/energy spectra for neutrinos and antineutrinos. The ability to determine the charge of the outgoing lepton will improve the sensitivity of the experiment for certain values of the MH and the CP-violating phase. Magnetization of some fraction of the DUNE FDs would enable this capability. GLoBES simulates DUNE with various magnetized fractions of the FDs to determine how much the sensitivity is improved as a function of the true oscillation parameters. The first part of this project was familiarization with GLoBES to produce FD event rate spectra, which will be shown. Next, spectra using a chisq test statistics to evaluate oscillation parameter sensitivities as a function of oscillation parameter values under various FD magnetization fraction assumptions, will be compared. This research is supported in part by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Award Number DE-SC0022023.

Contribution of Hadron Families to the QCD Equation of State

24 Mar
11:09am-11:19am
Innovations A

Alejandro Florez[1], Angel Nava Acuna[1], Claudia Ratti[1], and Naman Mehntiratta[2]
[1]University of Houston and [2]University of California, Los Angeles

Currently Lattice QCD simulations provide the best method of deriving the pressure of QCD as a function of the temperature. In the low-temperature regime, the thermodynamics can be understood in terms of a gas of non-interacting hadrons and resonances, but the contribution of the single hadronic species cannot be easily isolated. In this work we propose linear combinations of susceptibilities of conserved charges, that isolate the contribution of hadrons to the pressure of QCD according to their baryon number B, electric charge Q and strangeness S content. We build these partial pressures such that they vanish in the Stefan-Boltzmann limit. This generates a non-monotonic behavior which can be used to identify the melting temperature of each hadron family. We test the validity of these linear combinations in the Hadron Resonance Gas (HRG) model and compare them to available lattice QCD results.

"Flattenicity", a modernized classifier to select particle collisions with multiple soft partonic interactions

24 Mar
11:21am-11:31am
Traditions

Jose Modesto Alanis III, Dr. Omar Vazquez Rueda, and Dr. Rene Bellwied
The University of Texas Rio Grande Valley, University of Houston, NuSTEAM

Event classifiers based either on the produced charged-particle multiplicity or the angular emission spectrum have been used extensively in proton-proton (pp) collisions by the ALICE collaboration at the LHC. In particular, the study of the charged-particle multiplicity in forward direction allowed for the discovery of strangeness enhancement in high-multiplicity pp collisions.

Multiplicity-based event classifiers are double edged with regards to requiring a high charged-particle multiplicity biases, hence data on our conclusions on the origin of the strangeness enhancement are obscured by such parameters. In this context, we introduce a new event classifier, flattenicity; which uses the charged-particle multiplicity calculated in the forward region.

To illustrate how this tool works, pp collisions at 13 TeV simulated with PYTHIA 8 are explored. The sensitivity of flattencity to multi-partonic interactions as well as to the "hardness" of the collision will be discussed. PYTHIA 8 predictions for the transverse momentum spectra of light flavor hadrons as a function of flattenicity will be visualized and touched upon.

Improving resolution through better biasing of a Dual-Axis Duo-Lateral position sensitive resistive face detector

24 Mar
11:33pm-11:43pm
Traditions

Sebastian Regener, A. B. McIntosh, K. Hagel, A. Hannaman, A. Abbott, R. Rider, B. Harvey, L. W. May, L. A. McIntosh, M. D. Youngs, and S. J. Yennello

Texas A&M University Cyclotron Institute

A Dual-Axis Duo-Lateral (DADL) Position-Sensitive Silicon Detector, used in the Forward Array Using Silicon Technology (FAUST), was previously developed to record data on position and energy as high-energy charged particles pass through. It is important to make improvements to the DADL in position and energy resolution so that we measure improved correlation functions, map the thickness of targets and detectors in respect to position, and quantify the dead layers thickness of a DADL. We explore how varying the biasing scheme allows for improved resolution: biasing on the guard ring and faces of the detector. By manipulating where we send bias across the faces of our DADL, we would be able to improve our resolution. Finding the best resolution bias configuration would allow for accurately mapping the DADL dead layer. In addition to biasing, we investigate adding external resistors to the silicon. By adding external resistors, we reduce the charge split asymmetry, effectively improving the energy threshold for particles near the edge of the detector. We explore this by reducing charge splitting by adding an external resistor (2k Ω) in series with the face of the DADL.

Constraining nuclear symmetry energy with resonant shattering flares

24 Mar
11:45am-11:55am
Traditions

Rebecca Preston and William Newton

Texas A&M University–Commerce

Many terrestrial experiments and neutron star observations have been used to constrain the nuclear symmetry energy, a property of nuclei that gives us information about how neutrons and protons interact. The nuclear symmetry energy is the energy cost of converting protons to neutrons. Neutron stars are a stellar laboratory that allows us to explore nuclear matter at densities much higher than nuclear saturation density. Using a resonant shattering flare we can probe the symmetry energy at the same densities of terrestrial experiments like PREX. During a RSF the crust of the neutron star is excited until it shatters and releases a fire ball, the shattering being detectable in the GW signal by a coincident timing detection of the fire ball detected by gamma ray telescopes. Resonant shattering flares can provide a complementary probe of nuclear symmetry energy, comparable to those of terrestrial nuclear experiments. We show that probes of different regions of a neutron star probe different physics.

Lunch & Plenary Session II

24 Mar
12:00pm-1:15pm
Conference A-C

Listening to the Universe with Gravitational Waves

Katerina Chatziioannou, Ph.D.
California Institute of Technology

In 2015, the twin LIGO detectors in Hanford, Washington and Livingston, Louisiana observed gravitational waves emitted during the collision of two black holes. Predicted in 1917 by Albert Einstein, a mere two years after he had introduced the theory of General Relativity, gravitational waves allow us to gain access to the Universe that is invisible with traditional electromagnetic radiation. In this talk, I will describe what gravitational waves are, how they can be detected, what they have already taught us about the Universe, and where the nascent field of gravitational wave astrophysics is heading to in the next decade.

Parallel Session IIa: Physics Education Research/Physics Education II

24 Mar
1:45pm–1:55pm
Pride

OPTYCs - Year 1

Thomas O'Kuma
Lee College

The Organization for Physics at Two-Year Colleges (OPTYCs), https://optycs.aapt.org, has offered a number of workshops this year, primarily online. In this presentation, I will describe some of the past and upcoming workshops occurring between now and the Fall TS AAPT Meeting.

24 Mar
1:57pm–2:07pm
Pride

Retention and Class Interaction Strategies

Jess Dowdy
Abilene Christian University

The purpose of this talk is to highlight and focus on retention and interaction strategies the author and the author's department implemented beginning in the Fall of 2022. Strategies will highlight an approach that delivered essentially 100% retention in calculus-based physics I. Overall, for the department, the fall to spring retention was highlighted by the administration at over 90% for the fall/spring period as an example for all to know in a university wide email. Come hear how cell phone usage, late work, out of class experiences, targeted recruiting, and more have all played a part in this success story.

The Frontiers in Science (FIS) Program: promoting STEM graduate enrollment and training the faculty of the future.

24 Mar
2:09pm–2:19pm
Pride

Greg Morrison[1], Margaret Cheung[2], Paul Whitford[3], and Elebeoba May[4]
[1]University of Houston, [2]Pacific Northwest National Lab, [3]Northeastern University, [4]University of Wisconsin Madison

Significant demographic disparities exist in students pursuing STEM careers, due in part to the differences in support and guidance undergraduates receive when considering future careers. In this talk, we describe a 10-week paid summer research opportunity for undergraduates: the Frontiers in Science (FIS) program. Undergraduate participants are recruited from Minority-Serving Institutions and are paired with a graduate student or postdoc mentor, who design the undergraduate research project and advise their mentee on scientific questions as well as time management. Mentors and mentees join in a weekly guided conversation over lunch, discussing professional development topics to prepare them for success in graduate school. Participating undergraduates have reported a statistically significant increase in interest in applying for graduate school. Mentors feel more prepared to mentor students in a future faculty position and better understand students from diverse backgrounds. The FIS program strengthens the pipeline of diverse students into graduate school in STEM fields as well as training the faculty of the future on how to be good mentors.

Physics & Music, Building a Pipe Instrument

24 Mar
2:21pm–2:31pm
Pride

Timothy Renfro and Adam Clifton
McMurry University

As part of a music major's senior project, physics and art came together to create a new addition to the university's instrument catalog. Resonance physics was explored. Steel alloy pipe was cut according to a previously published length. Tuning of the pipe showed a slight change in lengths. Resulting data showed small variation possibly from the pipe being welded seam pipe. Final product, a pipe key-board with an almost scary wind chime sound.

The Electron's Structure

24 Mar
2:33pm–2:43pm
Pride

James C. Espinosa
Weatherford College

The classical model of the electron was unsuccessful in many ways. Among a few of its defects were its instability, its size, and lack of magnetic moment. In addition, scientists were puzzled how Gilbert Lewis' valence theory of molecules could be accommodated by it negative charge. We will demonstrate that the core problem lies in Maxwell's equations and then present the structure based on a Newtonian theory of electricity. We will give tentative values of its size and shape and show how its size may have a cosmological connection.

Parallel Session IIb: Astrophysics and Space Science II

Detecting precession in gravitational waves emitted by binary black holes

24 Mar
1:45pm–1:55pm
Traditions

Michael Kesden, Evangelos Stoikos, Nathan Steinle, Saif Ali, and Lindsay King
University of Texas at Dallas

Binary black holes (BBHs) emit gravitational waves (GWs) as they inspiral towards merger. They also have spins that can be misaligned with their orbital angular momentum, like the 23.5 degree misalignment between the Earth's spin and its orbit around the Sun. Spin misalignment causes the BBH orbital angular momentum to precess about the total angular momentum as the BBHs inspiral. This precession modulates the amplitude and phase of the emitted GWs and can therefore be detected if the signal-to-noise ratio (SNR) of the observed GW event is sufficiently high. We describe how BBH spin misalignment modulates GW emission and determine the SNR thresholds for detecting regularly precession as functions of the precession amplitude and frequency.

The rotational period distribution of massive magnetic field white dwarfs

24 Mar
1:57pm–2:07pm
Traditions

Zorayda Martinez and Kurtis Williams
Texas A&M University-Commerce

Rapidly rotating white dwarfs (WDs) have the potential to come about by either double degenerate mergers or weak coupling between the core and the outer envelope during the asymptotic giant branch (AGB). For both cases, knowledge of the rotational period distribution places tight constraints on the evolution of angular momentum transfer. Here we present initial results from a study of the rotational period distribution of 14 massive ($M > 0.9M_{\odot}$), magnetic, DA WDs observed by the Transiting Exoplanet Survey Satellite (TESS) and analyzed with the Lightkurve python package. We present periodograms, folded light curves, and statistics from this sample and compare the period distribution to that of other published rotating WDs. We also discuss ongoing searches to increase the sample size of massive, magnetic rotating WDs.

A direct detection method of galaxy intrinsic alignment in nonlinear regimes in photometric surveys

24 Mar
2:09pm–2:19pm
Traditions

Avijit Bera, Leonel Medina Varela, Vinu Sooriyaarachchi, and Mustapha Ishak

The University of Texas at Dallas

Intrinsic alignment of galaxies is a serious source of contamination in weak-lensing surveys and a limiting systematics for photometric surveys in constraining dark energy equation of state and the amplitude of matter fluctuations. The self-calibration (SC) technique is a model-independent approach to separate the gravitational shear-galaxy Intrinsic ellipticity (GI) correlation and the gravitational shear-gravitational shear (GG) correlation from the measured cosmic shear correlations. After a direct measurement of the galaxy density-galaxy intrinsic ellipticity (gI) correlation in the surveys, the SC derives the (GI) correlation through a scaling relation for cross-correlating redshift bins. We have developed an extended version of the SC scaling relation, which will be suitable for the nonlinear galaxy intrinsic alignment model and non-linear galaxy bias. Our work covers the tidal alignment and tidal torquing (TATT) model for the IA of galaxies. For Gaussian-like photometric bins, we observe that the scaling relation is accurate within 5% and 10% for the non-adjacent and adjacent bin pairs, respectively. These levels of accuracy signify that the GI contamination can be suppressed by a factor of 10 or larger for all cross-correlating bin pairs if other errors are negligible.

Signatures of Supermassive Black Holes

24 Mar
2:21pm–2:31pm
Traditions

Lindsay King

The University of Texas at Dallas

Supermassive black holes (SMBHs) are among the most intriguing objects in the Universe with masses ranging from millions to billions of solar masses. They are thought to reside at the centers of most galaxies, including our Milky Way. In this talk we will discuss several signatures of SMBHs in cosmological simulations and in multi-wavelength observations. We will focus on the role that SMBHs play in gravitational lensing by galaxy clusters, and by massive galaxies.

24 Mar
2:33pm–2:43pm
Traditions

Spectroscopy with Consumer Telescopes

Caleb Melton and Larry Isenhower
Abilene Christian University

In this project, I will be researching a way to use a consumer grade telescope for spectroscopy by designing an adapter to attach a CCD Spectrograph to the focuser of a telescope. Normally spectroscopy is out of the budget of a University like at Abilene Christian University since the instruments get complicated and expensive, but with designing a part to use a commercially available spectroscopy box with a telescope would allow us to do basic level spectroscopy. What this project will do is allow people interested in astrophysics be able to print the adapter for a 1.25" or 2" eyepiece and catalog different stars based off of their absorption spectrum, see the different elements that make up a nebula, and calculate the redshift of a galaxy. The requirements for a setup like this will be a telescope mount that can directly connect to a computer and be controlled by the computer, a telescope with a 1.25" or 2" focuser. The only other parts required for this project will be a spectroscopy box, and the 3D printed eyepiece adapter that I will be designing.

Parallel Session IIc: Professional Skills and Negotiation Workshop

24 Mar
1:45pm-2:45pm
Innovations A

Professional Skills and Negotiation

Barbara Szczerbinska
Texas A&M University Corpus Christi

A workshop for students on professional skills and negotiation.

Parallel Session IIc: SPS Talks

Electrodeposition of Lead Oxide Thin Films onto n-type Si (111) Wafers for use in the Development of Perovskite/Si Tandem Solar Cells

24 Mar
3:45pm-3:55pm
Innovations A

Matthew Oliver
Stephen F. Austin State University

Lead based perovskite materials have shown high power conversion efficiency (PCE) in recent years. Current manufacturing methods for perovskite-based materials are long, expensive processes that are ineffective when moving towards large scale manufacturing. The goal of this paper is to explore using the electrodeposition method to produce Lead Oxide thin films on n-type Si (111) wafers and take the resulting p-n junction and produce a Perovskite/Si Tandem solar cell using spin coating and annealing methods. The methods used to characterize the thin films include Scanning Electron Spectroscopy and X-Ray Crystallography. Current work has shown the ability to electrodeposit the Lead Oxide film successfully onto copper strips as a proof of concept and work can continue fine tuning the deposition on the Silicon wafers. These cells have the ability to not only employ methods that are currently widely used in industry currently but are also based on Silicon wafers which are widely available.

Developing Labs that Derive Student's Inquiry and Critical Thinking Processes

24 Mar
3:57pm-4:07pm
Innovations A

Jinung (Michael) Kim
Abilene Christian University

Students learn how to apply what they learn in a classroom to a real-world related task through laboratory activity and demonstration. The project focused on redesigning and reinforcing two labs from the Engineering Physics I course (EPI) at Abilene Christian University (ACU) to help students understand the topics better. The chosen physics concepts were Galilean Relativity and Forces and two-dimensional motion. Relativity and vector analysis get more important as students go to upper-level physics courses, so it is beneficial for the students to understand these topics before they move on. The lab materials were created consisting of pre-lab, post-lab, lab instructions and worksheets. The pre-and post-labs have similar problems, and their averages were compared to evaluate the effectiveness of the redesigned labs. The status of the project will be presented along with any preliminary findings. We hope these changes will lead to improved scaffolding for their understanding of reference frames and two-dimensional motion.

24 Mar
4:09pm-4:19pm
Innovations A

Numerically Approximating Partial Differential Equations

Cody Morgan

Stephen F. Austin State University

This study investigates a special class of mathematical equations, known as partial differential equations (PDEs), used to model multivariable systems and real-world phenomena. Numerical approaches, including the employment of MATLAB's pdepe function and the central-difference method, are utilized to compare results with known analytical formulations. Specifically, this research focuses on three types of PDEs. The first is the equation for one-dimensional heat conduction, which is fundamental to studies related to heat transfer in engineering, while the second is the equation for a wave on a string, an elementary concept for understanding wave propagation in physics. Lastly, it is shown that the renowned Schrödinger Equation takes the form of a PDE and can be solved using numerical methods; this is a well-established law in the field of quantum mechanics, hence, its significance is the motivation for this research. Solutions to example PDEs exhibited in this study are depicted as graphs and surfaces in MATLAB, which can then be used for conceptual analysis.

24 Mar
4:21pm-4:31pm
Innovations A

Evaluating Neutron Star Binding Energies Using Rotating Accreting Models

Nathan Moore and William Newton

Texas A&M University-Commerce

Neutron star binding energy increases due to accreting matter from neighboring astronomical bodies, and decreases due to the star spinning up, increasing its angular velocity. We present a novel set of models that account for both increasing angular velocity and accreting matter to track a neutron star's evolution. We arrive at these models through studying and reconfiguring computational investigations from the past, particularly a code which generate a model for a given fixed baryon mass and angular velocity and another that takes it from one baryon mass and angular velocity to the next one through accretion to obtain a full picture of internal and external processes of neutron stars.

24 Mar
4:33pm-4:43pm
Innovations A

The Search for Exoplanets: TESS

Alyssa Auten
Stephen F. Austin State University

Exoplanets are planets that orbit stars outside of our solar system. There are multiple methods to detect these plants, one of them being transit photometry. This method takes light data from stars and graphs the light over time. A periodic dip can be seen and measured to give information about the planet orbiting said star. TESS Objects of Interest (TOIS) are analyzed in collaboration with the TESS Follow-up Observing Program (TFOP) to look for false positives while actual candidates are sent off for further observations.

24 Mar
4:45pm-4:55pm
Innovations A

The struggle of building an autonomous robot: an IEEE story

Hannah Gex
Stephen F. Austin State University

Building a robot for an IEEE robotics competition is a challenging project to work on. There are always new problems arising and things that need to be fixed or changed. For this year's IEEE Region 5 Robotics Competition the goal is to build a fully autonomous ground robot that has the ability to scan QR codes and drive through boxes as well as communicate with a commercial aerial drone, which is also fully autonomous and able to scan QR codes. There are many things that go into building a robot, weather it is a robot for an IEEE competition or just for fun. This talk will explore the process used by the IEEE Robotics group at Stephen F. Austin State University to design and build their robot for the Spring 2023 IEEE Region 5 Robotics Competition and its associated complications.

Parallel Session IIIa: Biophysics and Medical Physics I

Surface Defect-Mediated Antimicrobial Interactions of Microcrystalline ZnO

24 Mar
3:45pm-3:55pm
Pride

Dustin Johnson[1], John M. Reeks[2], Alexander Caron[3], Vivek Athipatla[4], Dr. Shauna McGillivray[3], and Dr. Yuri Strzhemechny[2]

[1]Texas Christian University, [2]TCU - Physics, [3]TCU - MEDlogy, [4]Carroll High School

ZnO exhibits significant potential as an antibacterial agent at the nano- and microscale due to demonstrated selective toxicity and growth inhibition for a wide range of bacteria as well as the ability to inhibit formation of biofilms. As such, leveraging of the antimicrobial properties of ZnO-based materials for biomedical applications is quite promising, and efforts in realizing this potential are growing. Novel applications are hindered, however, by the lack of understanding surrounding the fundamental mechanisms behind these antibacterial behaviors as well as the influence of the local environment. Herein we present the results of our studies investigating the interactions between ZnO microparticles (MPs) and both Staphylococcus Aureus bacteria and varying environments on the physicochemical and optoelectronic properties of the ZnO surfaces. Antibacterial assays are complemented by a range of pre and post exposure optical studies to elucidate changes in the MPs. Our results reveal that the antibacterial action of ZnO is primarily rooted in interactions between the crystalline surfaces and the extracellular material of the bacteria. We also demonstrate aqueous phosphate mediated interactions between ZnO and biological media which greatly reduces microbial growth inhibition.

Analyzing the impact of deuterated media on the glycolytic pathway of cancer cells via ^{13}C NMR spectroscopy

24 Mar
3:57pm-4:07pm
Pride

Cody Larsen, Khoa Nguyen, Kristen Alvaran, Yejin Park, and Lloyd Lumata

University of Texas at Dallas

Culturing cells in heavy water (D_2O) based media is known to trigger cytotoxicity, with greater deuteration leading to more significant cell death. Despite this, the influence of deuterated media on the metabolic pathways of cells is still lacking. This research aims to track the effects that deuterated media has upon glucose metabolism and lactate production via glycolysis in cultured neuroblastoma and glioblastoma cancer cells. Cancer cells were cultured for 48 hours with various percentages of deuterated media, and the resultant impact upon glycolysis was monitored via ^{13}C NMR spectroscopy. These and other accompanying results will be presented. This study is supported by the Welch Foundation grant AT-2111-20220331, US Department of Defense CDMRP grants W81XWH-21-1-0176, W81XWH-22-1-0105, W81XWH-19-1-0741, and W81XWH-22-1-0003.

Tracking the effects of LDH and hexokinase inhibitors on glucose metabolism in cancer cells using NMR

24 Mar
4:09pm-4:19pm
Pride

Asiye Asaadzade and Dr. Lloyd Lumata
University of Texas at Dallas

Sodium Oxamate is an inhibitor of lactate dehydrogenase (LDH), specifically LDH-A, an important enzyme that is active in cell and is responsible for catalyzing the reversible conversion of pyruvate to lactate. 2-Deoxy-D-Glucose (2DG) Hexokinase inhibitor also known for cancer treatment by inhibiting the glycolysis in tumor cell. In this work, we have investigated via carbon-13 nuclear magnetic resonance (NMR) spectroscopy the metabolic effect of varying concentration of sodium oxamate and 2DG administered separately and the role of glutamine on [1-^{13}C] glucose metabolism in a variety of cultured cancers cell including renal cell carcinoma (786-O), hepatocellular carcinoma (HepG-2), and glioblastoma (SfXL cells). Our results reveal that highest concentration of sodium oxamate and 2DG affect lactate production and other glucose metabolites in these cancer cell. Intra- and extra-cellular metabolic products of glucose will be discussed in light of the key role of glutamine in glucose metabolism. This study is supported by the Welch Foundation grant AT-2111-20220331, US Department of Defense CDMRP grants W81XWH-21-1-0176, W81XWH-22-1-0105, W81XWH-19-1-0741, HT9425-23-1-0062, and W81XWH-22-1-0003.

Probing the hyperdrive tricarboxylic acid (TCA) cycle in liver cancer using ^{13}C NMR

24 Mar
4:21pm-4:31pm
Pride

Melody Siroosian, Dr. Llyod Lumata, and Caroline Crocker
University of Texas at Dallas

Liver cancer, more specifically hepatocellular carcinoma (HCC) is one of the most common types of cancer worldwide. There is an unmet and urgent clinical need not only for more effective and targeted therapeutics but also for clear-cut and better diagnostic tools for early detection and accurate assessment of liver cancer. Cell culture of HCC cells (Huh-7 cell line) was done using DMEM with 10% FBS and doped with 5 mM ^{13}C-aspartic acid for 1 hr and 48 hrs. A control without aspartic acid was also prepared and tested. The samples were done in triplicate and measured using a 600 MHz NMR spectrometer. Both cell and media extracts were analyzed to obtain NMR results. NMR results show that aspartic acid entered the tricarboxylic acid through oxaloacetate and produced alpha-ketoglutarate, citrate, phosphoglycerate, and a number of other TCA metabolites. This study is supported by the Welch Foundation grant AT-2111-20220331, US Department of Defense CDMRP grants W81XWH-21-1-0176, W81XWH-22-1-0105, W81XWH-19-1-0741, HT9425-23-1-0062, and W81XWH-22-1-0003.

A Redox-Reversible Switch of DNA Hydrogen Bonding and Structure

24 Mar
4:33pm-4:43pm
Pride

Melodee Seifi[1], Ayman Alawneh[2], Ashan Wettasignhe[1], Reema McMullen[1], Ivan Breton[2], Jason D. Slinker[1], and Robert D. Kuchta[2]

[1]The University of Texas at Dallas, [2]University of Colorado

Electrical control of the bonding of individual DNA base pairs endows DNA with precise nanoscale structural reconfigurability. Here, alloxazine DNA base surrogates were synthesized and incorporated into DNA duplexes to function as a redox-active switch of hydrogen bonding. Circular dichroism (CD) revealed that 24-mer DNA duplexes containing either one or two alloxazines exhibited CD spectra and melting transitions similar to DNA with only canonical bases, indicating the constructs adopt a B-form conformation. However, duplexes were not formed when four or more alloxazines were incorporated into a 24-mer strand. Thiolated duplexes incorporating alloxazines were self-assembled onto multiplexed gold electrodes and probed electrochemically. Square wave voltammetry revealed a substantial reduction peak centered at -0.272 V vs. Ag/AgCl reference. Alternating between alloxazine oxidizing and reducing conditions modulated the SWV peak in a manner consistent with the formation and loss of hydrogen bonding, which disrupts the base pair stacking and redox efficiency of the DNA construct. These alternating signals support the assertion that alloxazine can function as a redox-active switch of hydrogen bonding, useful in controlling DNA and bioinspired assemblies.

Parallel Session IIIb: Plasma / Atomic, Molecular and Optical / Condensed Matter (3:45pm–5:30pm)

Studying the ultrafast photoinduced lattice dynamics using MeV Ultrafast Electron Diffraction (MUED)

24 Mar
3:45-3:55
Traditions

Sumit Khadka, Sean Guthrie, and Byron Freelon

University of Houston

Ultrafast electron diffraction (UED) allows for the investigation of light-induced dynamics on an ultrafast timescale through the use of pump-probe spectroscopy with femtosecond pulses of an electron beam. MeV electron beams at facilities like the ATF and BNL enhance the quality of experiments by reducing space charge effects and facilitating access to high-order reflections with superior signal-to-noise ratios. Our study focuses on the impact of 800 nm light on MoTe2, a transition metal dichalcogenide with potential applications in fast-switching electronics. Our findings highlight the leading influences of the Debye-Waller factor on specific Bragg peaks and non-linear effects such as atomic displacements. Temperature variations reveal

significant differences in lattice dynamics, with potential stacking faults indicated by differences in time series from Bragg peaks of the same family. Our study illustrates the feasibility of using MeV UED to investigate ultrafast lattice dynamics in transition metal dichalcogenides and uncover non-thermal photoinduced dynamics in MoTe2.

Investigation of Co/CuO Interface by X-ray photoelectron spectroscopy

24 Mar
3:57pm-4:07pm
Traditions

Anil Chourasia

Texas A&M University-Commerce

The technique of X-ray photoelectron spectroscopy has been employed to study the chemical interaction at the Co/CuO interface. Thin films of cobalt titanium were deposited on CuO at room temperature by e-beam method. The thickness of the film was varied between 3 Å and 10 Å. The cobalt 2p, oxygen 1s and copper 2p regions were investigated. The spectral data show the reduction of CuO to elemental copper. Cobalt was observed to get oxidized to CoO. The thickness of CoO depended upon the initial thickness of the cobalt overlayer. The reaction is observed to continue until the cobalt overlayer was 7 Å thick. Beyond this thickness unreacted cobalt was observed. The thickness of the overlayer was increased. The spectral data under the 2p peaks of cobalt were utilized to determine the width of the interface. The variation in the interface width has been investigated as a function of the annealing temperature.

Properties of Defects Produced by Electron Irradiation of Graphene at 25 keV and Dosages Between 10^{15} and 10^{17} e^-/cm^2

24 Mar
4:09pm-4:19pm
Traditions

Ibikunle Ojo, Evan Hathaway, Roberto Rodriguez Gonzalez, Pashupati Adhikari, Sathish Vishal, Bhanuprakash Kunam, Khalid Yousef, Jingbiao Cui, Wonbong Choi, and Jose Perez

University of North Texas

Studying the effect of electron irradiation in the energy range of 1 – 30 keV is crucial in understanding the extent to which the properties of graphene could be altered by electron beam lithography and scanning electron microscopy. We report on the properties of defects produced by electron irradiation of exfoliated monolayer graphene on SiO_2 exposed to 25KeV electrons at dosages between 10^{15} e^-/cm^2 and 10^{17} e^-/cm^2. As the dosage increases, we find that the Raman D peak, ID to Raman G peak, IG ratio (ID/IG) increases and then decreases after a maximum ID/IG is reached, in excellent agreement with the reported equation for the two-stage amorphization trajectory in graphene exposed to Ar ion bombardment. In the second stage, we observe an increase in the full width at half maximum (FWHM) of the

Raman D, G, and 2D peaks by 3, 6, and 3 cm^{-1}, respectively Based on the assumption that ID/IG is proportional to the defect density, we compute the activation energy for defect healing, Ea of 0.49 eV, which is less than the 0.95 eV reported for vacancy defect, but in the range, Ea = 0.28 eV and 0.58 eV reported for hydrogen and hydroxyl adsorbates respectively. We conclude that graphene does not become amorphous in the second stage and the defects formed are likely adsorbates.

Thermodynamic and mechanical stability of TiO_2 phases at high pressures using first principle calculations

24 Mar
4:21pm-4:31pm
Traditions

Jared Pohlmann, Manjula Raman, Anjy-Joe Olatunbosun, Lily Bonds, Kenneth Park

Baylor University

Various phase of TiO_2 has been investigated under various high pressures, using all-electron density functional theory with meta-generalized gradient approximation. Specifically using the non-empirical strongly constrained and appropriately normed (SCAN), the equilibrium lattice parameters are in excellent agreement with experimental data in many cases and in general more accurate than those predicted using GGA. With increasing pressure, the order of stability is determined as rutile, anatase < columbite < baddeleyite < orthorhombic I < cotunnite, consistent with experimental observations. Finally, from the calculations of the elastic constants, we study mechanical properties such as bulk modulus, shear modulus, Young's modulus, and Poisson's ratio as well as the elastic stability, dictated by the Born stability criteria.

Continuously graded CdSe quantum dots: Tomorrow's bright single photon emitters

24 Mar
4:33pm-4:43pm
Traditions

Christopher B. Marble[1,2], Donghyo Hahm[2], Zachary L. Robinson[2], Vladislav V. Yakovlev[1], and Victor I. Klimov[2]

[1]Texas A&M University, [2]Los Alamos National Laboratory

Single photon emitters (SPE) are essential building blocks for proposed quantum technologies. CdSe core/shell quantum dots (QDs) provide an "atom-like" system that approximates an ideal SPE. In this talk, we discuss the ongoing progress to improve the SPE properties of single CdSe QDs. We present synthesis and spectroscopic analysis of wurtzite-CdSe/CdS, mixed shell $CdSe/Cd_{0.5}Zn_{0.5}S$, and continuously graded $CdSe/Cd_xZn_{1-x}Se/ZnSe_yS_{1-y}$ QDs. We compare their behaviors at room and cryogenic temperatures against the behavior of ideal SPE emitters using techniques including photoluminescence spectroscopy, Michelson interferometry, and Hanbury Brown and Twiss interferometry. We also address efforts to mitigate undesirable behaviors observed in QDs including oxidation, blinking and charging. We observe a factor of 3 reduction in linewidth at cryogenic temperatures, substantial charging at cryogenic temperatures, and verify the linewidth-coherence time relation ($\Delta E\ \Delta t = 2\hbar$).

Determining Electrochemical Charge Transfer Rates with Machine Learning

24 Mar
4:45pm-4:55pm
Traditions

Austen Adams, Sauraj Jha, David J. Lary, and Jason D. Slinker
University of Texas at Dallas

Electrochemistry of surface bound processes is of great importance for the study of sensors, batteries, catalysts, fuel cells, and many other emerging technologies. Within the study of surface bound processes, the electron transfer rate is beneficial to extract to understand the details of the surface and nearby redox-active molecules. Square wave voltammetry is often leveraged for surface bound study of electronic processes, but while the yield of charge transfer is directly estimated from the peak current, extracting the rate of charge transfer requires multiple voltammetry measurements and/or detailed modeling. We introduce a method for the determination of the surface bound electron transfer rates from large sets of square wave voltammogram curves using random decision tree ensembles, neural networks, and gaussian process regression algorithms. We applied these to reproduce computational measures of transfer rates extracted from first principles, with consistently accurate results, and a mean percent error of 1.5-2%.

Probing lone pairs and vacancies effects on optoelectronic properties of TeO_2 polymorphs from first principles calculations

24 Mar
4:57pm-5:07pm
Traditions

Hoa H. Nguyen, Robin T. Macaluso, and Muhammad N. Huda
University of Texas at Arlington

With a high refractive index and third-order optical susceptibility 50 times larger than silica glass, tellurium dioxide-based glasses have attracted much attention for their optoelectronic properties and technological applications. Three known tellurium dioxide phases are α-TeO_2, β-TeO_2 and γ-TeO_2. First-principles density functional theory calculations on the structural, electronic, and optical properties of all three TeO_2 polymorphs were performed to investigate the effects of Te^{4+} $5s^2$ lone pairs and oxygen defects on the local atomic structure and optoelectronic properties with a focus on α-TeO_2. Hybrid functionals were employed with generalized gradient approximation (GGA) to emphasize the localization of the lone pairs. All three crystalline TeO_2 phases are wide-gap semiconductors with Te^{4+} $5s^2$ lone pairs contribution near the Fermi level, affecting the optical properties. Furthermore, due to the presence of the lone pairs and the favorable oxygen defects, the local symmetry of α-TeO_2 is broken; creating asymmetric electron density, which contributes to the cause of the nonlinear optical effect.

Workshops I

Intermediate-Advanced Lab - Particle Detection for Beginners

24 Mar
3:45pm-5:45pm
Science Bldg 135

Toni Sauncy
Texas Lutheran University

Labs beyond the introductory level present challenges. Lab setups can be expensive, and expertise can be elusive. Many departments have aging equipment. In this workshop we will discuss how some nuclear/particle physics experiments can be developed at a relatively low cost using an open-source model.

Alternates and Inexpensive Ways to Show Physics Concepts

24 Mar
3:45pm-5:45pm
Science Bldg 146

Regina Barrera, Stephanie Ingle, and Thomas O'Kuma
Lee College

Do you have ways of showing or engaging Physics Concepts that is a must see? Why don't you bring it with you and show it to us? Are you scratching your head trying to figure out how to engage your students? Join us. You may come out of this workshop with ideas that may help you in your instruction. I will bring some items that I use for outreach and recruiting. One of the items we will make is the Spectroscope. It is a kaleidoscope that uses hatch gratings with tape, paper tubes, paper clips, and rubber bands. Another is a demonstration of alternating current or the fingerprint of a gas. It just uses a neon bulb, power cord, and a toy. These ideas and much more will be illustrated (and some make and take) in this workshop. Again, if you have something that demonstrates a concept in Physics, please bring it to share with us! Let us build a network for exchanging ideas to engage students. This workshop is proudly supported by the Organization of Physics in Two Year Colleges, OPTYCs, `https://optycs.aapt.org`.

SPS Outreach: Solar Eclipse Event Planning Workshop

24 Mar
3:45pm-5:45pm
Science Bldg 107

Larry Isenhower
Abilene Christian University

Come join other SPS students and advisors plan and coordinate events related to the two upcoming solar eclipses. An annular eclipse crosses from New Mexico into Texas and down into the Gulf of Mexico on Oct. 14 2023 and then on April 8, 2024 a total solar eclipse heads NE across Texas from Mexico and into Arkansas. These last about 3 hours from beginning to end and have about 4 minutes at the maximum. These will provide a great opportunity to engage with the broader public and we will to discuss best practices, ideas for advertising, and how to coordinate this across our Zone.

Posters

Exploring the Electrojet and Joule Heating Relationship Through Model-Observation Comparisons

24 March
5:30pm-6:30pm
Conference A-C

Rana Abdulazeez, James Davis, Pavani Rambachan, Tre'shunda James, and Ramon Lopez

University of Texas at Arlington

The processes in which electrical currents in the ionosphere dissipates energy into the ionosphere through frictional heating is referred to as Joule Heating. Joule heating has some important space weather impacts, including satellite drag resulting from the expansion of the thermosphere. In this study, we investigate the relationship between the simulated auroral electrojet index (AE) and simulated Joule Heating using the Space Weather Modeling Framework (SWMF; a global magnetohydrodynamic (MHD) model) for multiple events. Since the SuperMAG electrojet (SME) is considered to be a more global measure of the electrojet strength, we will also correlate the relationship between a simulated SME and the simulated Joule heating for each event. Additionally, we will compare the simulated currents to observations from AMPERE and SuperMAG. Preliminarily, we find there to be a linear relationship between the simulated Joule Heating and the simulated AE index, as has been reported for observations.

Novel method for synthesis of magnetic Graphene Oxide and GO-Ferrocene hybrids at rom temperature using mechanical defects and insertion

24 March
5:30pm-6:30pm
Conference A-C

Jorge Arturo Andujo, Yohannes W. Getahun, and Ahmed A. El-Gendy

University of Texas at El Paso

This study reports on the synthesis and magnetic properties of hybrid materials consisting of graphene oxide and ferrocene. The samples were prepared by a facile ball-milling process and characterized using various analytical techniques, including scanning electron microscopy, energy-dispersive X-ray spectroscopy, X-ray diffraction, and vibrating sample magnetometry. Our results show that the GO-Fc hybrids exhibit ferromagnetic behavior at room temperature, with magnetization values reaching as high as 3.0 emu/g. This is a significant improvement over previous attempts at ferromagnetic graphene, which have reported values of 0.2 emu/g or less at around 2K, and 5.5 emu/g at 62K. The observed magnetism in our samples can be attributed to the formation of a spin-coupled network between the ferrocene molecules and graphene oxide sheets. Furthermore, our findings suggest that the GO-Fc hybrids could potentially serve as a new class of molecular magnets with improved magnetic properties compared to metallocene sandwich compounds, which are currently the

most popular candidates for molecular magnets. Overall, our study provides new insights into the magnetic properties of graphene oxide hybrids and offers a promising route for the development of high-performance magnetic materials.

24 March
5:30pm-6:30pm
Conference A-C

Slow and Fast-moving Magnetic Clouds

Cristian Bahrim, Evgeny Romashets, and David Matherne
Lamar University

Interplanetary disturbances caused by solar flares or disappearing solar filaments can travel through the inner heliosphere in 2 - 5 days. We model and compare two interplanetary magnetic cloud (MCs) which produced recorded geomagnetic disturbances: a slow-moving MC, which produced a geomagnetic storm on April 17, 1999, and a fast-moving MC, which produced a similar storm on May 15, 1997. We adopted a dynamics model developed by Romashets and Vandas (Journal of Geophysical Research, 2001), which utilizes real parameters of the solar wind: speed, number density of particles, temperature, and magnetic field. Parameters of MCs are determined from in-situ measurements at 1 AU. The clouds are considered as toroids. MCs are driven by three forces: gravitational, drag, and diamagnetic. The spike speed of the MC is reached at 2.6 solar radii, and is 1,200 km s^{-1} for the slow-moving MC and 2,500 km s^{-1} for the fast-moving MC. The experimental time between the launch of the solar coronal mass ejection and the arrival time of the MC near Earth's orbit has been reported by Marubashi et al. (Solar Physics, 2015). It took 70 H for the fast-moving MC, and 100 H for the slow-moving MC to reach the Earth's orbit, which is 7% and 16% in agreement with Marubashi's data.

24 March
5:30pm-6:30pm
Conference A-C

An Optoelectronic Switch with Two Linearly Polarized TEMoo cw-Lasers Interacting with Silica Glasses

Cristian Bahrim and Rishi Bharadwaj
Lamar University

We study the interaction between two linearly polarized Gaussian cw-diode lasers of 532 nm incident simultaneously on a crown glass with the opacity wavelength of 100 nm. This allows us to have an optical linear regime in the interaction between the laser beams and the silica dipoles located on the glass surface. A capacitor voltage set up across the dielectric assists the reflection of the probe by the surface, thus shifting away the resonant frequency of the dipoles from the frequency of the incident probe laser. We analyze the parallel component of the reflectance normalized to the total component within a range of 15 degrees near Brewster angle, which is 56.571 degrees for a radiation of 532 nm interacting with crown glasses. Because the two lasers have a long temporal coherence, they also interfere, and clear fringes are observed in a region 7 degrees wide located at angles larger than the Brewster angle, where the reflectance is much stronger. At angles of incidence of 62 and 63.2 degrees, the

fringes flip from minima at 0.3 volts to maxima at 6 volts. This is a remarkable result, which makes our system to work like an optoelectronic switch, with ON/OFF positions: the reflection of the probe is shut OFF for lower voltages and released at higher voltages.

24 March
5:30pm-6:30pm
Conference A-C

Photometry of Planetary Candidate TYC 3985-1894-1

Katie Bailey
Stephen F. Austin State University

The star TYC 3985-1894-1 was designated as a planetary candidate during sky surveys completed by the Transiting Exoplanet Survey Satellite (TESS). After being identified as a TESS Object of Interest (TOI), the star must complete a five-step verification process through the TESS Follow-Up Operations Program (TFOP) to either confirm the existence of an exoplanet, or determine it to be a false positive. The first step of the TFOP is ground-based, seeing-limited photometry, which helps to identify false positives created by eclipsing binaries, while also being able to measure transit timing to produce more accurate light curves.

24 March
5:30pm-6:30pm
Conference A-C

Redesigning Gateway Science Courses and its Impact on Minority Students

Christopher S. Baird, Donna Byers, Gregory McGovern, Nick Flynn
West Texas A&M University

As part of meeting the objectives of a five-year NSF S-STEM grant, the six gateway science courses at West Texas A&M University were redesigned. These courses were: Basic Biology 1, Basic Biology 2, Chemistry 1, Chemistry 2, General Physics 1, and General Physics 2. This grant aims to improve the education of low-income and minority students in STEM career tracks. The course redesigns were systematically carried out by the CoPIs of the grant from 2019 to 2023 and included elements such as: external curriculum consultants, use of published best practices, extensive administration of surveys to the students and TAs involved, discussions with faculty, the writing of lab manuals, and the acquisition of new lab equipment. The grades of African American, Hispanic, and White students in these courses before and after the course redesigns were analyzed. The results of this analysis will be presented.

Initial-Final Mass Relation of Massive White Dwarfs in the Open Cluster Messier 11

24 March
5:30pm-6:30pm
Conference A-C

Eric Burns
Texas A&M University-Commerce

The initial-final mass relation is a direct measure of the integrated mass loss of white dwarf progenitor stars. It provides the end state evolution of the cores of the asymptotic giant branch stars, whose models are complicated by intricate and delicate physics, especially in intermediate-mass (4-8 solar mass) progenitors. Additionally, the initial-final mass relation provides direct constraints on the upper mass limit of white dwarf progenitors. Despite significant ongoing efforts, the initial-final mass relation remains poorly constrained for intermediate-mass stars, due in large part to the steepness of the initial mass function and combination of data from multiple star clusters. Here we present initial results of a determination of the intermediate to high-mass initial-final mass relation in the rich open star cluster Messier 11. Archival data from the HST shows Messier 11 contains a well populated white dwarf cooling sequence, including candidates for ultra-massive white dwarfs. We use the HST multi-band photometry to calculate the mass and surface gravity of individual white dwarfs in the cluster, and from there determine each object's initial mass. We then describe potential implications our results have on the high-mass end of the initial-final mass relation.

Reconfiguration and Testing of ACU's Cosmic Ray Test Stand

24 March
5:30pm-6:30pm
Conference A-C

Isla Casey
Abilene Christian University

A scintillator is a type of material that emits photons whenever it is struck by ionized radiation (charged particles), and it is this property that makes them useful in a wide range of applications. One application is to use scintillators to detect cosmic rays from space. Cosmic rays create a shower of particles after colliding with atoms in the earth's upper atmosphere. Muons created in these showers have been well studied and are useful for testing particle detectors near the surface of the earth. Abilene Christian University Cosmic Ray Test Stand uses two arrays of scintillators to provide triggers for when a cosmic ray muon has passed through the detector testing volume. One array is above the volume and the other is placed below. The testing volume is a light tight box with space to place various particle detectors for testing purposes. We present work done this summer reconfiguring the trigger detectors for this system to optimize their light detection efficiency.

Understand and Control Quantum Decoherence of an Ensemble of Quantum Emitters

24 March
5:30pm-6:30pm
Conference A-C

Mauricio Cerda, Zachary Brown, and Myoung-Hwan Kim
Texas Tech University

Primary objective is to realize and understand quantum sensing via a hands-on quantum emitter experiment, part of an ongoing research project regarding reconfigurable quantum emitters on an active nanocavity platform. Experiment is realized by using an optical setup of collimated lasers of temperature-controlled, high-powered infrared 980 nm and He-Ne overlayed to pump energy to an atom of a rare-earth doped crystal into an excited state. The excited state of the atom then gives a stimulated wavelength emission of 1536.57 nm to be filtered through a narrow band optical filter of 10-35 nm and observed for photoluminescence via a photodiode sensor and oscilloscope. Spectrum measurement is next achieved using a Czerny-Turner monochrometer, and fluorescence measurement lifetime is realized with an InGaAs/InP single-photon detector. Possible subsequent steps are low temperature magnetic field measurements via optical path extensions, measuring temperature dependence of fluorescence lifetime, and observing Zeeman effect. What is to be anticipated is to show that said device can be utilized as a working quantum sensor for purposes of both metrology and quantum computing by optical means and future educational laboratory material for undergraduates.

Looking for Ohm's Law in the Ionosphere

24 March
5:30pm-6:30pm
Conference A-C

Kacy Colstock-Millume, Tre'Shunda James, and Ramon Lopez
University of Texas at Arlington

Space Weather is the study of how the solar wind interacts with the near-Earth environment and the effects on technology and society. However, the dynamics of this interaction can be very complicated. The goal of this study is to determine if using a simple circuit as a proxy for the solar wind- magnetosphere-ionosphere interaction holds for determining the conductivity of the ionosphere. Being able to describe the ionosphere as a simple circuit where the solar wind provides the voltage, the ionosphere itself acts as a resistor, and the voltage over the ionosphere drives a current, should allow us to consistently determine the ionospheric conductivity using Ohm's law. We expect the summer to be more conducting than the winter in the northern hemisphere and vice-versa in the southern hemisphere since conductivity is driven in part by solar EUV radiation. Using Birkeland Current data provided by the AMPERE dataset and the solar wind electric field from the OMNI dataset, we present results from 2010 to 2016. Preliminarily, we find the conductivity in the northern hemisphere to be about twice as much as that in the southern hemisphere.

24 March
5:30pm-6:30pm
Conference A-C

Speed of Sound of a Dense Medium of Massive Fermions

Victoria Delgado and Efrain Ferrer
University of Texas at Rio Grande Valley

The speed of sound is an important tool to determine the inner structure of neutron stars. It is expected that the speed of sound square must be below the conformal limit, 1/3, if the star is only formed by hadronic matter, and that it must grow above that limit in the presence of quark matter. In this work, by using a free relativistic massive fermion system at finite density, we will study how the relation between the fermion mass and the chemical potential can determine the value of the speed of sound in the medium. The chemical potential in this context could be associated with a baryonic density. We will show then, that in the limit where the mass is larger than the chemical potential the speed of sound square will be smaller than 1/3, while in the opposite limit it will be larger than 1/3. This result is showing a parallelism with the results expected for hadronic and quark matter respectively and it is stressing the role of the mass-density ratio on the values of the speed of sound in those phases.

Acknowledgments: This research is supported in part by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Award Number DE-SC0022023 and by NSF grant PHY-2013222.

24 March
5:30pm-6:30pm
Conference A-C

The Modified Tychonic Universe

Charles Espinosa and James Espinosa
Weatherford College

Most students and many faculty believe that there is a preponderance of evidence for the belief for the heliocentric solar system. After polling astronomy classes for five years, we became convinced that students believe in heliocentrism due to authority and not to any scientific evidence. As a mental exercise and as a future teaching aid, we have constructed a modified Tychonic universe that fits all the typical observational data taught in upper division astronomy classes such as stellar parallax and aberration. In our research, we have found that Dr. Samuel Herrick wrote in his treatise "Astrodynamics" that geometrically there was no difference between geocentric and heliocentric models. He believed that only physics could decide between the two viewpoints. We will show that Newtonian physics cannot distinguish between them.

Reflectance Measurement of the New Mirror for the Cherenkov Beam Monitor Detector for E1039(SpinQuest)

24 March
5:30pm-6:30pm
Conference A-C

Ziyu Gao

Abilene Christian University

A Cherenkov detector is used for monitoring the proton beam intensity for the SpinQuest (E1039) experiment at Fermilab. The beam is delivered in a 4-second spill and this detector monitors each beam pulse (1 ns long followed by a 17.9 ns gap) within the spill. The proton beam goes through the gas inside the detector and produces Cherenkov light, the mirror redirects the Cherenkov light to an ND-filtered photomultiplier tube (PMT). The PMT signal is calibrated to measure the number of protons in the beam. A new mirror was customized for the E1039 Cherenkov detector. Having an accurate measurement of the mirror's reflectivity increases the confidence of the calibration for this detector. This poster will present the system used to measure the reflectivity of this mirror and the progress that has been made to calibrate these measurements using a NIST calibrated UV mirror. Supported by U.S. DOE Office of Science, Intermediate Energy Grant Number DE-FG02-03ER41243.

Theoretical calculation of detecting exoplanets via their Auroral Kilometric Radiation (AKR)

24 March
5:30pm-6:30pm
Conference A-C

Anshuman Garga

University of Texas at Arlington

Exoplanets' magnetic fields can help determine their interior structure, which is otherwise difficult to study, and can shed light on the stability of their atmospheres. Solar system planets with a magnetic field emit Auroral Kilometric Radiation (AKR) due to the cyclotron radiation of electrons orbiting the planet's magnetic field lines. In this project, we investigate the probability of detecting AKR emission of exoplanets. To do so, we collect information on detected and confirmed exoplanets from NASA's exoplanet archive data as well as other sources, and attempt to calculate their projected AKR emission.

Construction of an optical tweezers apparatus with a circularly polarized beam

24 March
5:30pm-6:30pm
Conference A-C

Addison Hild

Texas Lutheran University

Optical tweezers (or "traps") function by using focused laser light to trap and manipulate microscopic particles. The focused beam of light generates a region of potential energy inversely related to the intensity of light so that particles are attracted toward the point of highest intensity (the focal point). The cost of a typical turn-key optical trap (>$40,000) is beyond the budgets of many physics departments, particularly at smaller institutions. The goal of this work is to design and construct a working optical tweezers apparatus using off-the-shelf, low-cost components. The current function of the TLU Optical Tweezers apparatus, along with how design goals have been met, along with the addition of a circular polarizer used to exert torques and produce spinning particles using the focused beam will be discussed.

Searching for superradiance in biological systems

24 March
5:30pm-6:30pm
Conference A-C

Kassie Marble, Dominik A. Doktor, Georgi I. Petrov, and Vladislav V. Yakovlev

Texas A&M University

In 1994, Jibu et. al proposed that microtubules in neurons undergo biologically orchestrated coherent quantum processes. Microtubules are a likely candidate for biological quantum effects due to their crystal-like lattice structure, hollow inner core, and roles in intracellular transport and intercellular communication. Multiple mechanisms have since been proposed to explain this quantum communication process, one being superradiance. Theorists have suggested that tryptophan residues (the amino acid building block of microtubules) may exhibit a superradiant lower energy state and act similarly to photosynthetic antenna complexes. In this study, we test this tryptophan hypothesis by constructing a time correlated single photon counting fluorescence lifetime system to investigate the effect of changing concentration and excitation power on the fluorescence lifetime of lysozyme (a tryptophan-rich enzyme).

H- Lateral Collisions with Ag(111) Metal Surfaces Covered by Na Adsorbates

24 March
5:30pm-6:30pm
Conference A-C

Aaron Martinez and Bogdana Bahrim

Lamar University

Our study investigates the lateral charge transfer processes between H- projectiles and Ag(111) metal surfaces covered by Na adsorbates. In general, on top collisions with adsorbates have been studied in the literature [1-3]. However, to the best of our knowledge, lateral collisions, right on the side of the adsorbate, have not been investigated due to the complexity of physics involved. Our study will bring essential contributions not only to Fundamental Research, but also to a broad range of technological applications in various fields, such as Plasma-Wall Interactions, Catalysis, and Aeronautical and Space Engineering. The Wave-Packet Propagation method is successfully used to study the ion-surface interaction [3]. Compared to the on top configuration, the ion-surface projected density of states for various H- - Na lateral distances reveals interesting local effects, as well as adsorbate-induced states that are not visible otherwise. [1] E. V. Chulkov et al., Chem. Rev. 106 (2006) 4160. [2] S. Yu et al., Surf. Sci. 636 (2015) 13. [3] B. Bahrim, Surf. Sci. 726 (2022) 122176. Acknowledgements: This research is sponsored by the Office of Undergraduate Research at Lamar University

Neutrino detection event similarity based on mathematical graphs

24 March
5:30pm-6:30pm
Conference A-C

Destynne Oliver[1] and Daniel Cherdack[2], and Jorge Munoz[1]

[1]The University of Texas at El Paso, [2]The University of Houston

Many open questions remain about neutrinos, for example whether they violate charge and parity symmetry or whether they are their own anti-particles. Increasingly more precise experiments can help answer these questions by measuring neutrino oscillations, and the use of machine learning algorithms trained on simulated data can improve the detection of classification of events. We converted track events that resemble 2-dimensional heatmaps into mathematical graphs that can be used in novel machine learning algorithm based on graph similarity. We measured the similarity of several events and here we present those results.

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under Award Number DE-SC0021994.

Determining the reliability of OMNI data to predict solar wind conditions at Earth

24 March
5:30pm-6:30pm
Conference A-C

Rushikesh Patil, James Truett Davis, and Espen Fredrick
University of Texas at Arlington

Geospace models used in the simulation and prediction of space weather phenomena require a set of input conditions to drive model outputs. These conditions are often solar wind parameters 30 Re outside Earth's bow shock. As geospace models have become increasingly adapted for use in space weather forecasting, the ability to predict solar wind conditions near the bow shock ahead of their arrival at Earth has become imperative. One service designed to address this issue is the OMNI database. This database provides a collection of solar wind parameters from various spacecraft, mostly near the L1 Lagrange point, ballistically projected to the nose of Earth's bow shock. Probability distributions of correlation coefficients between ballistically projected OMNI data and in-situ data measured by near-Earth satellites such as THEMIS and ARTEMIS during periods when these satellites were near the Earth-Sun line have been found for IMF Bz, however probability distributions of other solar wind variables such as IMF By, velocity Vx, and ion density n have not been investigated. This study attempts to create probability distributions of correlation coefficients for these variables (By, Vx, n), as well as investigate relationships between probability distributions.

Metal to the Pedal: Digital Signal Processing Methods for Guitar Effects

24 March
5:30pm-6:30pm
Conference A-C

Kathryn Pinkerton
Stephen F. Austin State University

In the area of musical instruments, mainly pertaining to the guitar enthusiast, guitar pedals are widely used. Guitar pedals take the analog signal from a guitar, then manipulate and amplify the signal through an amplifier. This process is known as Digital Signal Processing (DSP) and is used in a variety of applications ranging from image processing to seismology. Through this project, DSP was explored and used in the creation of a prototype guitar pedal which allowed for the development of various computer codes to create guitar effects. These included clean, booster, tremolo, and distortion. To accomplish this, an open-source guitar pedal project was recreated from the ground up. This project used an Arduino microcontroller which gave a user-friendly platform for testing and analyzing code in the C and C++ programming languages. Some elements of mechanical engineering were also used in the design of an enclosure for the guitar pedal. Precise dimensioning and stress analysis simulations were done to ensure that the enclosure would work for the Printed Circuit Board (PCB) design. This project has been unique in that it has encompassed the fields of computer science and both mechanical and electrical engineering, making it an interesting, multidisciplinary project.

Classical and Quantum Representation of Electromagnetically Induced Transparency and Its Applications

24 March
5:30pm-6:30pm
Conference A-C

Yuri Rostovtsev and Haley Timmons
University of North Texas

Electromagnetically induced transparency (EIT) is a highly useful phenomena where an opaque medium can become transparent when specific conditions are met when applying two laser beams. In our talk we present a classical analog of the EIT that consists of two simple harmonic oscillators coupled to each other. We discuss several applications of the EIT to spectroscopy, superconducting circuits, and metamaterials. The coupled oscillators used for the model for EIT can be implemented by optomechanical elements. In order gain deeper insights in possible applications of our model of the coupled oscillators, we consider them quantum mechanically to see the difference between results obtained via classical and quantum approaches.

A New Explanation for the Structure of Gravity and Magnetic Fields

24 March
5:30pm-6:30pm
Conference A-C

Gh. Saleh
Saleh Research Centre

By using a experiment we obtained frequency, energy, etc., ($EB = \mathrm{S}e \times m$ (j), $\vartheta = \mathrm{S}\vartheta \times \sqrt{m}$ (Hz), Where "EB" is Magnetic Energy, "ϑ" is Magnetic Frequency, "Se" is Saleh Energy constant, "m" is the mass of the magnet in units of grams; "Sϑ" is Saleh Frequency Constant.) magnetic fields are the same as gravity fields, by a difference that the frequency of gravity fields is higher than the frequency of magnetic fields, so its energy would be higher. (As a small flame is structurally the same as a large flame, it can be said that the structure of gravitational and magnetic fields is the same.) Look at the tides phenomenon on the earth, this phenomenon is the effect of Moon on Earth. The amount of energy required to move due to tides is very high, but the speed of Moon's rotation around the earth does not decrease impressively, and it can be said that this speed is a constant value. In fact, the energy consumed of displacement, friction, etc. has no effect on the speed of Moon, and this is because of the gravitational chain between Moon and Sun, and the main source of gravity is Sun. In this paper we will explain the relation between magnetic and gravity and the manner to have gravity from magnetic filed.

24 March
5:30pm-6:30pm
Conference A-C

New Discoveries about the Magnetic Fields

Gh. Saleh

Saleh Research Centre

As we know, force lines or magnetic fluxes are invisible and on the other hand, they pass through objects. Considering these characteristics, we can certainly say that the frequencies of magnetic fluxes are obviously higher than those of visible waves. It can therefore be deduced that the start of the frequency range of the magnetic field must be 10^{15} Hz. In this paper we are going to calculate the frequency and energy of the Magnetic fields. On the other hand, we will explain the Intense Attraction and Repulsion of the Magnetic poles and Nature of Magnetic fluxes.

24 March
5:30pm-6:30pm
Conference A-C

Maximum Solubility of Ergosterol and Stigmasterol in Various Lipid Membranes

Muhammad Bilal Siddique and Huang Juyang

Texas Tech University

The chemical structure of cholesterol is very similar to that of other sterols, such as bacteria sterol ergosterol and plant sterol stigmasterol. However, mammalian cells universally utilize cholesterol. Scientists have been wondering what makes cholesterol so unique that animal cells prefer cholesterol, not other sterols. We recently measured the maximum solubilities of ergosterol and stigmasterol in various types of lipid membranes (DPPC, DOPC, POPC) using an anti-correlation light scattering technique. We found that cholesterol has the highest solubility in lipid membranes (67 mole %) regardless the saturation of lipids, while other sterols have much lower solubilities. Furthermore, ergosterol and stigmasterol have lower solubilities (15% - 22%) in unsaturated (DOPC) lipid bilayers and higher solubilities (40% - 55%) in saturated (DPPC) lipid bilayers. Our result shows that a small difference in sterol structure can result in a major difference in the behavior of sterols. The uniquely high solubility of cholesterol is essential for cholesterol to perform its biological functions in mammalian cells.

Visuospatial Skills and Learning Astronomy: Visualizing Eclipses

24 March
5:30pm-6:30pm
Conference A-C

Mary L. Urquhart[1], Rebecca Lindell[2], and Michele McColgan[3]
[1]University of Texas at Dallas, [2]Tiliadal STEM Education, [3]Siena College

Teaching the how and why of eclipses often involves the use of modeling and simulations to illustrate both the scale and complexities of the Earth-Moon-Sun geometry. However, the success of these approaches depends upon both the use of multiple representations and the visuospatial skills of students. To improve students' visuospatial skills, researchers at Siena College have created over one hundred Manipulative Augmented Reality Visualizations to Learn Spatially (MARVLS) to teach physics, chemistry, math, and engineering. Working with the MARVLS developers, we will be developing a Visualizing Eclipses MARVLS. In this poster, we will present the pedagogical design of the Visualizing Eclipses learning module and how it can augment using existing instructional eclipse models and representations. A connection to the upcoming total solar eclipse in the United States on April 8, 2024, and the preceding annular eclipse on October 14, 2023, gives Visualizing Eclipses particular relevance for astronomy educators.

Design & Fabrication of a Spray Pyrolysis Deposition Apparatus

24 March
5:30pm-6:30pm
Conference A-C

Maximilian Schaar, Toni Sauncy and Calvin Berggren
Texas Lutheran University

Research on thin film materials is an essential component for furthering materials science work at TLU. The study of thin film materials has applications to a wide range of technological fields and incorporates classroom content in the areas of modern physics, chemistry, mechanics, electricity and magnetism, and optics. This research aims at creating an apparatus for the deposition of thin films on to heated substrates using a technique known as spray pyrolysis. The apparatus will be used for numerous materials science projects. Development of the apparatus was driven by a set of design goals that included use of custom-made in-house parts and modular off-the-shelf components, and adhering to a low budget, along with a computer interface that makes the apparatus user friendly for inexperienced student researchers. Simultaneously, the apparatus will allow the user to maintain control over several variables that affect thin film deposition and impact film properties. Progress on the apparatus design and construction, along with solutions to addressing design constraints will be discussed.

Banquet: 6:30pm–8:30pm

After Dinner Speaker

24 Mar
7:30–8:15pm
Conference A-C

Educational Transformation at a Critical Time: The essential roles and promise of physicists

Noah Finkelstein, Ph.D.
University of Colorado Boulder

Significant, perhaps unprecedented, attention is being paid to the needs for transformation within the fields of science, technology, engineering, and mathematics (STEM) education at the undergraduate level. This talk examines how higher education STEM disciplines, and physicists and physics educators in particular, are positioned to contribute to these discussions and address our challenges. After examining the key opportunities and pressures facing physics education, I present samples of change at the individual, the course, and the departmental scales reviewing: how we can build on understanding of student reasoning to study and transform our introductory through upper division courses, studies of how our environments do and do not support women in physics, and models for engaging in sustainable and scalable transformation.

Saturday, 25 March 2023

Plenary Session II

25 Mar
8:45am-9:30am
Conference A-C

Physics Teaching and Equity

Michael Marder, Ph.D.
The University of Texas at Austin

As a matter of civil rights, every high school student should have the opportunity to take at least one good physics class. Texas has come closer to meeting this goal than any other state. But these are turbulent times, and the K-12 teaching profession is undergoing radical shifts. Teacher resignations and retirements are soaring. Preparation of secondary teachers by universities has been declining for a decade, and new teachers in Texas increasingly come through pathways that require no preparation in advance, and in some cases no preparation at all. It may seem remote from the responsibility of a physicist to ensure the quality of our children's education, but it is not clear who is engaging in that struggle anymore, and thus some of us must take it up for ourselves.

25 Mar
9:35am-10:25am
Conference A-C

Teaching: The Best-Kept Secret

Dawson Lang
Jefferson Academy Secondary School

If we want these students to consider majoring in physics, it is essential to let prospective students know that teaching is a career option for physics majors. Therefore, participants will dig into surprising data about the teaching profession in this presentation. Recruitment strategies and resources will also be shared to give students accurate information about their career prospects. All materials are professional quality, research-based, and have been extensively user-tested. Get the Facts Out is a partnership between the American Physical Society, the American Chemical Society, the American Mathematics Teacher Educators, and the American Association of Physics Teachers led by the Colorado School of Mines. SF #1821710 and 1821462.

Parallel Session IVa: Biophysics and Medical Physics II

^{13}C NMR study of the glycolytic pathway in colorectal cancer cells

25 Mar
11:00am-11:10am
Pride

Emmanuel Ameh and Lloyd Lumata
University Of Texas at Dallas

Colorectal cancer (CRC) is a major cause of cancer-related deaths in the United States. Sometimes referred to as colon cancer, CRC has a growing incidence and thus there is an urgent clinical need for early detection and more effective therapeutics. In this study, we seek to observe the effects of dichloroacetate (DCA) in the proliferation of cultured colon cancer cells (LoVo and Colo-205 cell lines) and its effects on glucose metabolism. Glucose is a major source of energy for normal cells. Unlike normal cells, cancer cells alter the pathway of glucose metabolism to produce lactate. Using 1-^{13}C NMR spectroscopy, we tracked how DCA affects this metabolism in cultured colon cancer cells. The details of these results will be presented. This study is supported by the Welch Foundation grant AT-2111-20220331, US Department of Defense CDMRP grants W81XWH-21-1-0176, W81XWH-22-1-0105, W81XWH-19-1-0741, HT9425-23-1-0062, and W81XWH-22-1-0003.

The Effects of Targeting MNK-eIF4E Pathway on Glioblastoma Proliferation and Metabolism probed by NMR Spectroscopy

25 Mar
11:12am-11:22am
Pride

Kathleen Cate Domalogdog
University of Texas at Dallas

Glioblastoma multiforme is one of the most aggressive and lethal cancer. Existing treatment involves tumor resection, radiotherapy, and adjuvant chemotherapy. Temozolomide (TMZ) is the existing gold standard of chemotherapy treatment. However, the tumor cannot be eradicated entirely, resulting in recurrence. Research shows that temozolomide activates the MNK $\frac{1}{2}$ pathway, wherein it phosphorylates eukaryotic initiation factor 4E (eIF4E), which was determined to play a role in cancer progression; Increased dosage of temozolomide elicits toxicity as well, wherein some patients reported neuropathic pain. Tomivosertib (eFT508) is a MNK 1/2 inhibitor that was shown to target the phosphorylation of eIF4E and the production of reactive oxygen species (ROS) in chemotherapy-induced neuropathy. This study aims to explore the efficacy of concurrent temozolomide and tomivosertib administration with ascorbic acid as a supplement in impeding glioblastoma metabolism and proliferation. NMR spectroscopic and other relevant data will be presented and discussed. This study is supported by the Welch Foundation grant AT-2111-20220331, US Department of Defense CDMRP grants W81XWH-21-1-0176, W81XWH-22-1-0105, W81XWH-19-1-0741, HT9425-23-1-0062, and W81XWH-22-1-0003.

Carbon-13 NMR investigation of galactose Biochemistry in cancer cells under normoxic and hypoxic conditions

25 Mar
11:24am-11:36am
Room

Daniel Anable and Lloyd Lumata
University of Texas at Dallas

The Le Loir pathway is a slow cellular metabolic pathway for the processing of galactose into glucose-1-phosphate which is then converted into glucose-6-phosphate for use in glycolysis. Traditionally, galactose is processed in the liver, kidney, and gut. We examined the metabolism of galactose in Huh7 and Hepg2 liver cancer cells under both normoxia (20% oxygen) and hypoxia (2% oxygen). When adding 5mM of [1-^{13}C] Galactose to complete media, we see a large boost in the C_3 lactate carbon under normoxia. However, under hypoxic conditions, the lactate peak returns to levels similar to unlabeled glucose. Finally, we examined the metabolism under a galactose only regime and showed both cell lines proliferated under both oxygen levels. These NMR results will be discussed together with other supporting data. This study is supported by the Welch Foundation grant AT-2111-20220331, US Department of Defense CDMRP grants W81XWH-21-1-0176, W81XWH-22-1-0105, W81XWH-19-1-0741, HT9425-23-1-0062, and W81XWH-22-1-0003.

Pericarp Thickness Estimation of Sorghum Kernels using Fiber-based Extended Focus Optical Coherence Microscopy

25 Mar
11:38am-11:48am
Pride

Dipankar Sen, Alma Fernández, Daniel Crozier, Brian Henrich, Alexei V. Sokolov, Marlan O. Scully , William L. Rooney, and Aart J. Verhoef
Texas A&M University

Sorghum is one of the most important sources of nutrition in Asia and Africa which together share about 75% of world population. Thickness of pericarp: the outermost layer of sorghum grain, is an important breeding criterion as it is related to storage stability, processing of food and popping quality. But most of the methods available to predict the thickness (e.g., removing the pericarp with scalpel) are destructive in nature. Therefore, we employ optical coherence microscopy (OCM), an important tool for morphological subsurface imaging with micrometer resolution to predict the pericarp thickness of sorghum kernels. We have developed an all fiber based novel OCM technique using Bessel-like beam which can achieve a lateral resolution of 3µm over an extended focus making non-invasive imaging very reliable. This technique has been used for morphological characterization of two different genotypes of sorghum kernels: BTx 2928 and RTx 430. The average pericarp thickness measured by this method are 74 µm and 43 µm respectively. We have also proposed an ellipsoidal model to estimate the average pericarp volume of the two genotypes which are in good agreement with previously reported X-ray Coherence Tomography (CT) measurements.

Parallel Session IVb: Nuclear and Particle Physics II

Particle Production as a Function of Transverse Spherocity in pp collisions at 13 TeV

25 Mar
11:00am-11:10am
Innovations A

Jeseleth Benavides, Omar Vaquez Rueda, Dr. Rene Bellwied
University of Houston

Proton-proton (pp) collisions with high charged-particle multiplicities at the LHC have revealed similar phenomena to the observed in Pb-Pb collisions, where a strongly interacting Quark Gluon Plasma (sQGP) is created. These include the observations of radial and anisotropic flow and the enhanced production strange particles. Since the mechanisms for hadron production are currently not well understood, particle production is explained using phenomenological models. For example, perturbative Quantum Chromodynamics (pQCD) models based on hard scatterings, such as PYTHIA, describe hadron production via string fragmentations and rope hadronization.

In this contribution, I will show results using the PYTHIA model and how event shape observables like spherocity can help to isolate and study events where particle production is dominated by soft or hard QCD processes. This is done in an effort to pin-point the underlying mechanisms of the collective behaviour observed in pp collisions systems, such as radial flow and long-range angular correlations.

Thermal Evolution of Generated EoS's using NSCool to Obtain Constraints on MXB 1659-29 Crust

25 Mar
11:12am-11:22am
Traditions

Amber Stinson[1], William Newton[1], and Dany Page[2]
[1]Texas A&M University–Commerce, [2]National Autonomous University of Mexico

Using the 1D Fortran cooling code, NSCool, we have modelled multiple generated equations of state (EOS) against data gathered with Chandra and XMM-Newton from the accretion source, MXB 1659-29 to gain constraints on the neutron star's crust. Varying chosen parameters allow us to see their direct effects on the predicted thermal evolution of these EOS's and can aid in adjustment of them. We will discuss the process of thermal evolution of an accreting neutron star along with some preliminary results of our findings.

Multiple Scattering Characterization for Luminosity Measurements at the Electron-Ion Collider of the Brookhaven National Laboratory

25 Mar
11:24am-11:34am
Innovations A

Nicholas Brooks, Rene Bellwied, Premkumar Saganti, and Dhevan Gangadharan

NuSTEAM

Utilizing recently developed detector simulation software called DD4HEP (Detector Description for High-Energy Physics), we study the effects pertaining to luminosity measurements at the anticipated Electron Ion Collider (EIC) currently in development at the Brookhaven National Laboratory. The EIC will be the first electron-nucleus accelerator operating in collider mode, for which commissioning begins at BNL around 2032.

Simulations of Particle Detection for the Proposed Electron Ion Collider at BNL

25 Mar
11:36am-11:46am
Traditions

Simba Wobogo, Dhevan Gangadharan, Rene Bellwied, Claudia Ratti, and Premkumar Saganti

NuSTEAM

Making use of the high energy particle acceleration and detection software called DD4HEP (Detector Description for High-Energy Physics), we are generating simulations for the photon measurements and detection possibilities of high energy signals for the anticipated Electron Ion Collider (EIC) currently in development at the Brookhaven National Laboratory. The IC will be the only electron-nucleus collider operating in the world once commissioned which is expected to be around 2030. In partnership and support with the University of Houston's High Energy Physics Team, we are preparing the needed geometry for optimizing the placement of the detector systems for the high energy signals generated from the collision of high energy electrons with spin polarized protons. We present our initial geometry setup and the results from our simulations with anticipated high precision / high resolution of the signals in the detector system.

25 Mar
11:48am-11:58am
Innovations A

Resistor and HVDB Testing for DUNE Field Cage

Brian Reid, Dr. Jaehoon Yu, Dr. Andrew Brandt, Michael Solek, Eric Garcia, Tan Ho, Nicholas Chasteen, Atharva Dange, Claire Cavalier, Morgan Elliot, Gajendra Gurung, Wooyoung Jang, Rohit Raut, Brad Brown, Jacob Bogenschuetz, Adrian Gomez, Vamshi Vavilla, and Bilal Zafar

The University of Texas at Arlington

The Deep Underground Neutrino Experiment will consist of a Near Detector located at Fermilab and a Far Detector located at Sanford Underground Research Facility (SURF) in South Dakota. The detector systems will be comprised of liquid argon-based time projection chambers enclosed by field cages that define the active detector volume and ensure uniformity of the electric field within that volume. This uniformity is heavily dependent on the precision of the resistors used to construct High Voltage Divider Boards (HVDB) that will bridge gaps between extruded aluminum profile electrodes in the field cage modules. We report here on the design and implementation of the testing apparatus and procedures used to ensure resistor and HVDB precision.

25 Mar
12:00pm-12:10pm
Innovations A

Environmental Impact on Resistor Testing for DUNE Field Cage

Brad Brown, Dr. Jaehoon Yu, Dr. Andrew Brandt, Brian Reid, Gajendra Gurung, Eric Garcia, Morgan Elliott, Claire Cavalier, Wooyoung Jang, Rohit Raut, Jacob Bogenschuetz, Atharva Dange, Adrian Gomez, Tan Ho, Nicholas Chasteen, Vamshi Vavilla, Bilal Zafar, and Michael Solek

The University of Texas at Arlington

The Deep Underground Neutrino Experiment (DUNE) seeks to explain the origin of matter by exploring neutrino interactions via two large-scale detectors and the world's most intense neutrino beam. DUNE will take place across two locations: Fermilab where the Near Detector is located, and the Sanford Underground Research Facility (SURF) in South Dakota where the Far Detector is located. These detectors utilize a liquid argon time projection chamber surrounded by a field cage that insures a uniform electric field. To create a uniform electric field, high voltage divider boards (HVDB) are used to evenly distribute voltage across the field cage modules. The uniformity of this field depends on the precision of the resistors used in the HVDB. While testing the resistors, the humidity in the test environment fluctuated greatly. Thus, an experiment was designed to determine an offset value to account for the change in humidity. We report here on the methodology used for the experiment, as well as how to mitigate the effect of environmental factors in the future.

Workshop II

WebVPython for Beginners: Integrating Coding in the Classroom

25 Mar
11:00am-12:30pm
Science Bldg 135

Thomas L. O'Kuma and Regina Barrera

Lee College

Over the last few years, there has been a push to integrate computational modeling in the introductory physics curriculum, both in high school and college. This is a workshop for novice coding learners, where participants will learn basic steps in WebVPython (also known as GlowScript) and practice with codes that demonstrate physics principles ranging from conceptual to calculus-based level. Participants will practice with activities that could be directly integrated into the classroom, starting with simple working codes where physical modelling will be incrementally added through guided steps. Further examples of classroom utilization of coding will be provided. Participants are asked to bring their own laptops and to create an account in webvpython.org before arrival. This workshop is proudly supported by the Organization of Physics in Two Year Colleges, OPTYCs, https://optycs.aapt.org.

Prepare for the Great Texas Solar Eclipses!

25 Mar
11:00am-12:30pm
Science Bldg 146

Mary Urquhart

The University of Texas at Dallas

Two solar eclipses are coming to Texas next fall and spring! On Saturday, October 14, 2023, an annular eclipse will sweep through Midland/Odessa and San Antonio with an excellent partial solar eclipse for the rest of the state. On April 8, 2024, parts of San Antonio, Austin, DFW, and East Texas will experience a total solar eclipse! Whether you teach high school or college, come learn about solar eclipses, eclipse resources, and how you and students of any age can safely observe them with or without any special equipment. Discuss connections to the physics and astronomy curriculum. Do you have solar eclipse resources of your own or are you already planning a viewing event on your campus or in your community? Come share your own resources or plans with others and look for opportunities to collaborate!

Increasing Student Success and Cultivating an Inclusive Culture in the Physics Department Through a Learning Assistant Program

25 Mar
11:00am-12:30pm
Science Bldg 107

Eleanor Close

Texas State University

The Learning Assistant (LA) Model is a structure for near-peer instructional support that has demonstrated benefits across a wide range of courses and institutions. The Physics LA Program at TXST has dramatically increased learning and retention in the majors' introductory sequence since its launch in 2012. In addition, our LA Program is structured specifically to create inclusive community and a shared culture of mutual support. LAs describe a sense of belonging to a supportive and collaborative community of peers, near-peers, and faculty. In an interview study with women of color and LGBTQ+ women physics majors, participants specifically identified the LA experience as supporting their success and characterized ways in which the LA Program positively influenced their broader experiences in the department. In this workshop, participants will be introduced to the Learning Assistant Model; learn about the theoretical frameworks of Communities of Practice and Critical Physics Identity; use these frameworks as lenses for understanding video data from weekly LA Prep sessions and interviews; and discuss LA Program elements supporting inclusive culture and positive physics identity development. This work has been supported in part by NSF #1557405, #0808790 (PhysTEC), and #1928596.

Lunch, Student Awards & Plenary Session IV

Across the Universe ... across the Curriculum

25 Mar
12:45pm-1:45pm
Conference A-C

Pamela Gossin, Ph.D.

The University of Texas at Dallas

Astronomy and cosmology originated as both humanistic and scientific endeavors. Since early human history, our storytellers, poets, shepherds, elders and wise women have all observed the heavens, tried to make sense of what they saw there, and shared their findings. The belief that astronomy and cosmology are exclusively "science" is a relatively recent invention! Evidence of HUMA-STEM collaborations (and celebrations) of humanity's quest to understand the universe are ubiquitous throughout the history of human learning and can inspire many kinds of meaningful "integrated" learning experiences across the curriculum.

Workshop III

25 Mar
2:00pm-4:30pm
Science Bldg 135

Radioactivity Workshop for HS Teachers

Daniel K. Marble[1], Christopher Marble[2], and Kassie Marble[2]
[1]Tarleton State University and [2]Texas A&M University

Interested in teaching your students about radioactivity? Want your students to perform activities that are analogous to ^{99m}Tc bone scans and PET scans? Want your students to measure the rest energy of an electron to an accuracy of a few percent using gamma rays? Curious how physicists at CERN use coincidence techniques to sort through the billions of possible events to find something interesting like a Higgs event. In that case, this workshop is for you. The Physics program at Tarleton State University has been offering hands-on nuclear physics activities to high school students as part of our two-week residential summer camps for several years using the equipment in our accelerator laboratory. We have modified many of these activities so that they now can be performed at your high school using new low-cost spectroscopy systems. Each high school workshop participant will be given write-ups to all the activities with additional teacher materials to guide class discussions and the activities relevance to important industrial and medical physics applications. Participants completing the workshop will keep the $2,000+ of materials they use to perform the workshop activities. This workshop is sponsored by the Nuclear Power Institute and the Texas Section of the AAPT.

25 Mar
2:00pm-4:30pm
Science Bldg 146

STEPP into Kinematics and Newton's Laws of Motion

Mary Urquhart
University of Texas at Dallas

Explore the power of a free-to-use, web-based tool for high school and college introductory physics classrooms developed with funding from the National Science Foundation at the University of Texas at Dallas. With the Scaffolded Training Environment for Physics Programming/Problem-solving (STEPP) you and your students will have the power to visualize and explore 1-D motion, 2-D motion, and Newton's laws. See word problems in your own introductory mechanics curriculum come to life! Build conceptual understanding of motion alongside physics vocabulary and multiple mathematical representations while also building students' computational thinking and problem solving skills. No programming skill is required!

25 Mar
2:00pm-4:30pm
Science Bldg 107

MBL using bluetooth sensors from PASCO and Vernier

Regina M. Barrera, Tom O'Kuma, and Stephanie Ingle
Lee College

Join us in demonstrating activities using Bluetooth sensors from PASCO and Vernier Science Education. These sensors connect directly to a smart device such as a tablet or computer with Bluetooth capabilities. For some, when one uses a smart device, there is no need for a "middleman" using these sensors. The demonstrations that will be shown in this workshop will be Light, Circuits, Momentum, Harmonic Motion, Sound, and many more.

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