Spring 2022 Meeting

Texas Section of the American Association of Physics Teachers

Texas Section of the American Physical Society

ABILENE
CHRISTIAN
UNIVERSITY

Zone 13 of the Society of Physics Students

HOSTED BY THE DEPARTMENT OF ENGINEERING & PHYSICS

Abilene Christian University

Abilene, TX

March 10-12, 2022

Meeting Schedule

Thursday, March 10

Events to occur in the Onstead Science Center (OSC)

Time	*Event*	*Location*
6:00 PM - 8:00 PM	Registration	OSC Lobby
6:00 PM - 8:00 PM	SPS Ping Pong Games	OSC Lobby
6:00 PM - 8:00 PM	SPS Board Game Room	OSC 345
6:00 PM - 8:00 PM	SPS Video Game Room	OSC 342
7:00 PM - 8:30 PM	TSAAPT ExCom meeting	OSC 331
7:00 PM - 8:30 PM	TSAPS ExCom Meeting	OSC 365
8:30 PM - 9:00 PM	Joint TSAAPT/TSAPS ExCom meeting	OSC 331

Friday, March 11

Events to occur in the Hunter Welcome Center (HWC)
W2 will occur in the Onstead Science Center (OSC)

Time	*Event*	*Location*
7:30 AM - NOON	Registration	HWC Hallway
8:00 AM - 10:30 AM	Welcome and Plenary Talks	HWC A
8:15 AM	Matthias Perdekamp Plenary	HWC A
9:05 AM	Caleb Brooks Plenary	HWC A
9:45 AM	Steven Biegalski Plenary	HWC A
10:30 AM - 10:45 AM	Coffee Break	HWC Hallway
10:45 AM - 12:40 PM	W1: Circuits Using Arduino	OSC 325

Friday, March 11 (cont.)

Time	***Event***	***Location***
10:45 AM – 12:15 PM	Parallel Session 1 – SPS Session I	HWC A
	Parallel Session 2 – Astronomy	HWC B
	Parallel Session 3 – AAPT General Physics	HWC C
12:15 PM – 1:30 PM	Lunch	HWC Hallway
12:15 PM – 1:15 PM	TSAAPT Business Meeting	HWC A
1:30 PM – 3:00 PM	Parallel Session 5 – SPS Panels	HWC B
	Parallel Session 6 – Nuclear Physics	HWC C
	Parallel Session 7 – AAPT Teaching Approaches	HWC Lynay Classroom
1:30 PM – 3:30 PM	W2 – Inquiry Laboratory Investigations in Physics	OSC 325
3:00 PM – 5:00 PM	Poster Session	HWC Lobby
3:30 PM – 5:30 PM	W3 – Alternative or Inexpensive Ways to Show Physics Concepts	OSC 325
6:30 PM – 9:00 PM	Banquet	HWC A

Saturday, March 12

Events to occur in the Onstead Science Center (OSC) and Hunter Welcome Center (HWC)

Time	***Event***	***Location***
8:00 AM – 10:30 AM	Registration	HWC Hallway
8:30 AM	Kenric Davies Plenary	HWC A
9:15 AM	Israel Portillo Plenary	HWC A
10:00 AM – 10:15 AM	Coffee Break	HWC Hallway

Saturday, March 12 (cont.)

Time	*Event*	*Location*
10:15 AM – 12:15 AM	W4 – STEP UP Physics Together Workshop	HWC Lynay Classroom
10:15 AM – 12:15 AM	W5 – ALPhA Advanced Lab Workshop	OSC B21
10:15 AM – 11:30 AM	Parallel Session 8 – SPS Session II	HWC A
	Parallel Session 9 – Optical, Molecular, and Atomic	HWC B
	Pre-Service Teacher Panel	HWC C
12:15 PM – 12:30 PM	Presenter Awards and Closing Statements	HWC A

Friday Plenary Sessions

Friday Mar. 11, 8:15-9:05 – HWC A

A Case Study in Nuclear Proliferation - The Iran Nuclear Deal and the Responsibility of Physicists

Matthias Grosse Perdekamp – We will start with a brief review of consequences of nuclear war and terrorism and describe the system of arms control treaties that have been put into place to contain this threat over the past 70 years. In the recent past, several arms control agreements have been facing significant challenges. The United States and Russia have ended the Intermediate Nuclear Force Treaty. Failure in the negotiations for an extension of the New START treaty was avoided only at the last moment. The United States has withdrawn from the JCPOA (the “”Iran Nuclear Deal””). Both the United States and Russia have withdrawn from the Open Skies Arms Control Treaty. We will focus on the Iran Nuclear Deal, an agreement that aims to prevent the proliferation of nuclear weapons to Iran. We will discuss the recent history, including the US withdrawal in 2018 and current efforts to re-negotiate the agreement.

Friday Mar. 11, 9:05-9:45 – HWC A

Rethinking Nuclear Power: Small Systems, Big Potential

Caleb S. Brooks – Nuclear microreactors are a new class of nuclear fission technology capable of producing up to roughly 20 MWth depending on design. Beyond their size, the primary distinguishing features over other fission systems is that microreactors are designed to be: factory built, tested, and delivered to site by truck, rail, or ship; plug-and-play with minimal onsite construction or preparation; capable of long operational periods between refueling (10-20 years); and minimal decommissioning required to return the site to greenfield status. Nuclear microreactors are a promising technology to enable a clean, climate conscious, energy future.

Fueled by wide bipartisan legislation for advanced nuclear technologies, the Department of Energy (DOE), Department of Defense (DOD), and National Aeronautics and Space Administration (NASA) all have recent and growing programs related to these advanced power systems. The University of Illinois at Urbana-Champaign is preparing to be an early site for microreactor technology as an advanced research and test reactor. The campus deployment focuses on the research, education, and training necessary to see advanced reactor technology become widely deployable, marketable, economic, and ultimately a safe and reliable option for a clean energy future.

Friday Mar. 11, 9:45-10:30 – HWC A

Creating Future Energy Communities with Advanced Reactors

Steven Biegalski – Advanced nuclear power is the dynamic energy source of future. The energy landscape is changing to flexible green power sources. Electrical power sources need to move from either being baseload power or load-following power to sources that are multifaceted. The smaller advanced nuclear plants are capable of placement in industrial and urban locations. Closer placement to industry facilitates utilization for applications ranging from hydrogen production, to synthetic gasoline production, to water desalinization, to power storage. Vanguard nuclear plants provide a versatile energy source that will impact the energy sector in broader ways that just electricity production. This presentation will review current trends in nuclear reactor design and layout the potential impacts this technology will bring.

Saturday Plenary Sessions

Saturday Mar. 12, 8:30-9:15 – HWC A

Current State of Physics Education Standards in Texas

Kenric Davies – Roughly every ten years, the State Board of Education (SBOE) and the Texas Education Agency (TEA) begin a process that results in a revision or rewriting of the science education standards for K-12 grades. In an effort to create a set of standards for Texas teachers that reflect current best practices and content needs, the steps in the process included input from a wide range of people and organizations. The Texas Section of the American Association of Physics Teachers (TSAAPT) and the Science Teachers Association of Texas (STAT) provided input at various points along the revision process helping to create a new set of standards which were adopted November/December 2021 and will be implemented in the 2023-2024 school year. In this talk, I will review the overall process conducted by the TEA and SBOE, how TSAAPT and STAT influenced the process, and how the new set of standards differ from those last adopted and implemented in 2010-2011.

Saturday Mar. 12, 9:15-10:00 – HWC A

Nusteam – Nuclear Science in Texas to Enhance and Advance Minorities

Israel Portillo - The NuSTEAM program is a collaborative effort by four Texas-based universities that offer an undergraduate traineeship project under the guidelines of the Department of Energy TBD-NP (Research Traineeships to Broaden and Diversify the Nuclear Physics community) initiative. The collaboration consists of the University of Houston (UH), University of Texas – Rio Grande Valley, University of Texas – El Paso and Prairie View A&M University.

In its first year, the program supported eight undergraduate students selected from those universities. The student's training begins with a six-week summer course at UH, followed by two weeks of hands-on experience in the laboratory environment at Brookhaven National Laboratory. Upon returning to their home institutions, the program allows the students to work on selected research topics during the Fall and Spring semesters.

In this talk, I will discuss the curriculum of the program and the experiences we had during the first year. I will present the metrics applied to determine student success, and I will discuss the future of this and other related federally-funded programs.

Banquet Guest Speaker

Friday Mar. 11, 19:00-19:45 – HWC A

Mission Systems Engineering of The James Webb Space Telescope

Michael T. Menzel – The James Webb Space Telescope (JWST), launched on December 25, 2021, is NASA's successor mission to the Hubble Space Telescope. JWST has been designed and developed to observe "first light" objects in the nascent universe, the evolution of galaxies over cosmic history, star birth within our own galaxy, planet formation and evolution both in our solar system and in solar systems around other stars and to make detailed observations of some of the recently discovered exoplanets. The JWST telescope has an aperture greater than 6 meters in diameter, and along with its compliment of science instruments must be cooled to cryogenic temperatures below 50K. It will be operated at the Sun-Earth L2 point to keep thermal sources such as the Sun and Earth in the same general direction so that their radiation can be shielded by a "tennis court sized" sunshield, allowing the payload to attain these temperatures passively. This presentation will give an overview of the JWST science and systems design from the perspective of the NASA Mission Systems Engineer.

Parallel Sessions

AAPT General Physics

Parallel Session 3 – Friday Mar. 11, 10:45-12:15 – HWC C

The Physics of a Car Crash

DAVE WALL (P) — Talk about momentum! Have you ever had a student ask about a car crash, one where they got hurt? I did and wound up testifying in court as an expert witness. Turns out, personal injury lawyers, in general, need to know more Physics. So, I got invited back in several other cases. Some involved big trucks and little cars. I love physics demonstrations. When asked, in those cases, I like to bring along a basketball and a tennis ball. Drop them together, tennis ball on top, and the tennis ball will go flying. I'll show you. Using conservation of momentum and the coefficient of restitution, you can figure out the acceleration of the little car in a 6-mph collision. The acceleration of the little car is greater than many insurance company adjusters seem to think.

Venturing Outside Physics: Teaching Courses for Non-Science Majors

ANDRA PETREAN (P) — Physics college professors spend most of their time teaching their discipline to either Physics majors or science majors. At a small liberal-arts school there are, however, opportunities to branch outside of physics. I will describe the various course I taught, from a more common hands-on conceptual Physics course, to a first-year seminar on nanotechnology and robotics, to a course on The Science of the Extreme" that explored the extremely small quantum world and the extremely large and fast world of relativity. I will elaborate on a recent opportunity in collaborating with an Economics professor on a course entitled "The equation for a resilient planet." I will describe the challenges and rewards that come from engaging with non-science students.

A Review of the Schuster Blackett Effect

CHARLES ESPINOSA, **JAMES C. ESPINOSA (P)** — The Schuster-Blackett Effect is an alternative theory to the dominant dynamo explanation of the magnetic field of the Earth and the other celestial objects. Schuster proposed in 1912 that there was a connection between the angular momentum of the Earth and its magnetic moment and suggested laboratory tests of his hypothesis. Blackett in 1947 revisited this idea and did an experiment which gave negative results. With the advent of artificial satellites and improvements in Earth based astronomical measurements of stellar objects, the idea that magnetic fields can be generated via a rotating mass became attractive again in the 1970's. We will review these measurements and the ensuing attempts to explain this seemingly strong astronomical evidence to support a connection between magnetism and gravitation. We will also outline a research program that will allow us to apply a Ritzian theory of electric interactions to elucidate the Schuster-Blackett effect.

AAPT Teaching, Curricular Approaches

Parallel Session 6 – Friday Mar. 11, 13:30-15:00 – HWC Lynay Classroom

The Implementation of a Specifications Grading Framework in a Heat and Mass Transfer Course

Robert Brown (P) — This talk will focus on the process of implementation of a specifications grading framework. In particular, the framework was implemented in a Heat and Mass Transfer course, but the process includes: a) the identification of student learning outcomes, b) prioritization of those outcomes, c) building a curriculum where those outcomes are clear to the students, and d) grading in a way that ensures achievement of the critical outcomes of the course.

Specifications grading is not one particular methodology, but rather a mindset that the course grades should be defined by attainment of the course learning outcomes. Traditional grading tends to obscure the actual learning attained by students in class, with curved grades simply comparing to other students, partial credit seeking to soften lack of attainment, and grades averaged over an entire semester completely washing out any record of actual attainment. Good grading should make expectations clear, uphold high academic standards, and authentically assess the desired student learning outcomes.

In particular, this implementation of specifications grading includes: a) division of course material into modules, which are assessed individually, b) pass/fail grading on modules, c) the use of ""tokens"" as a limited retake system for failed modules, and d) a level of student choice on non-priority student outcomes.

In addition to looking at the framework used in Heat and Mass Transfer, this talk will also investigate the difficulties encountered and the solutions developed to overcome them over three years of teaching the course. Existing challenges will also be named, with possible methods of overcoming those challenges.

Approach to Introduction of Computation to the Physics Curriculum at Texas State

David Donnelly (P) — The Physics Department at Texas State made a decision about 5 years ago to make computation an integral part of the Physics curriculum at the undergraduate level. This talk will present the approach the department has taken in implementing this decision, along with a discussion of things that have worked well, and some things that did not work so well.

STEP UP: Engaging Students in Discussion of the Underrepresentation of Women in Physics

Robynne M. Lock (P), Keely Scott, Conner Kelley, Geoff Potvin, Zahra Hazari — Efforts to increase the representation of women in physics need to include a focus on high school students and thus need to engage high school physics teachers. High school is often the first and last time that a student takes a physics class. Fortunately, nearly half of high school physics students are young women. STEP UP is a national community with the goal of inspiring young women to pursue physics in college. We have created two lessons for high school teachers to implement: Women in Physics and Careers in Physics. This talk focuses on the Women in

Physics lesson which explores the underrepresentation of women in physics and the role of implicit bias and cultural stereotypes. Students complete an assignment prior to the class discussion in which they reflect on the experience of women in physics. Classroom discussion is built around an interactive presentation on the underrepresentation of women in physics today and its causes. The presentation is designed to elicit students' personal experiences. Following the class discussion, students write an essay about how they perceive society's influence on women's career decisions and on their own individual career choices. We analyzed student work to examine the impact of the lesson on students' views. *This material is based on work supported by the National Science Foundation under Grant Nos. 1720810, 1720869, 1720917, and 1721021.

Improving Physics Education in the State of Texas

WILLIAM NEWTON (P), ROBYNNE LOCK, BAHAR MODIR, CLAY STANFIELD, MELANIE FIELDS — In this talk, I will outline two programs aimed at helping physics teachers improve their teaching and address physics teaching issues at the state level. I will first describe the Texas PhysTEC Regional Network, a partnership between Texas A&M University-Commerce, Texas State University, University of Houston, and University of Texas Rio Grande Valley funded by PhysTEC. The goal is to strengthen physics teacher preparation across the state, especially in the highest-needs areas, and grow a community that can address issues of physics teaching in Texas. We are in the process of creating a central website promoting physics teaching in the state, and contributions and suggestions by in-service teachers is essential. I will then talk about our online Master's in Physics for Physics Teachers, a program designed specifically for high school physics teachers.

Astronomy

Parallel Session 2 – Friday Mar. 11, 10:45-12:15 – HWC B

Using Multi-Messenger Observations of Neutron Star Crust-Shattering Events to Measure the Material Properties and Nuclear Physics of the Crust

WILLIAM NEWTON (P), DAVID NEILL, DAVID TSANG — In the new era of multimessenger astronomy - combining electromagnetic observations with, for example, gravitational wave observations - big strides have been made understanding the inspiral and merger of binary neutron stars. We can now robustly identify binary neutron star mergers with short gamma-ray bursts (sGRBs). In a small number of cases, precursor gamma-ray flares have been detected a few seconds before the sGRB. One possible explanation is that these arise from the shattering of the solid neutron star crust caused by resonant excitation of crust oscillations by the tidal field of the companion neutron star. We show here how, under this hypothesis, if we detect precursor flare and the gravitational wave signal of the inspiral together, we can make a measurement of the material properties of the crust and the underlying nuclear physics

A Three-Component Pulsar Glitch Model with Realistic Microphysics Glitches

FLINT MORGAN (P), WILLIAM NEWTON — Pulsars, rotating neutron stars, are observed to glitch every few months to years. Glitches are sudden spin ups of pulsars, thought to be caused by the coupling of the liquid core of the star to the solid crust. The properties of the glitch are determined by the strength of this coupling, which is quantified by a property called the mutual friction of the core, and the relative sizes of crust and core. Theoretically, the mutual friction depends on the effective mass of protons in the core, a quantity that can be measured in nuclear physics experiments, and on the neutron superfluid pairing gap, which is inaccessible to terrestrial experiments. We develop a three component glitch model, accounting for the superfluid in the crust, the superfluid in the core and the charged components of the star. In order to explore how the various components of the star and their properties influence predictions for glitches, we use a range of realistic equations of state, a range of mutual friction parameters informed by nuclear experiment, and a range of superfluid pairing models, and compare out results to the time evolution of the 2016 Vela pulsar glitch.

Modelling of May 12-15, 1997 Interplanetary Magnetic Cloud Propagation

CRISTIAN BAHRIM (P), EVGENY ROMASHETS — Based on the toroidal model proposed by Romashets and Vandas (Journal of Geophysical Research, 2001), we analyze the propagation of a magnetic cloud from a solar filament generated on May 12, 1997. This disappearing solar filament (DSF) is responsible for a strong geomagnetic storm which started 70 hours later. We use Marubashi et al. (Solar Physics, 2015) geometrical parameters of the cloud determined near the Earth's orbit, such as the aspect ratio (defined as the large radius over the small radius of the toroidal cloud) of 4.17. We compare the arrival time of the magnetic cloud calculated from our model with the experimental time. A difference of 6.6% is found.

Nuclear Physics

Parallel Session 5 – Friday Mar. 11, 13:30-15:00 – HWC C

Equilibrium and Dynamical Properties of Hot and Dense Quark-Gluon matter from Holographic Black Holes

JOAQUIN GREFA (P), CLAUDIA RATTI, ISRAEL PORTILLO, JORGE NORONHA, JACQUELYN NORONHA-HOSTLER — By using gravity/gauge correspondence, we employ an Einstein-Maxwell-Dilaton model to compute the equilibrium and out-of-equilibrium properties of a hot and baryon rich strongly coupled quark-gluon plasma. The family of 5-dimensional holographic black holes, which are constrained to mimic the lattice QCD equation of state at zero density, is used to investigate the temperature and baryon chemical potential dependence of the equation of state [1]. We also obtained the baryon charge transport coefficients, the bulk and shear viscosities as well as the drag force and Langevin diffusion coefficients associated with heavy quark jet propagation and the jet quenching parameter of light quarks in the baryon dense plasma, with a particular focus on the behavior of these observables on top of the critical end point and the line of first order phase transition predicted by the model.

[1] Grefa, J., Noronha, J., Noronha-Hostler, J., Portillo, I., Ratti, C., Rougemont, R. 10.1103/PhysRevD.104.034002

Bayesian Inference of Neutron Star Crust Properties Using Neutron Skin Constraints

REBECCA PRESTON (P), DR. WILLIAM NEWTON — It is known that the thickness of neutron skins - the layer of excess neutrons at the surface of neutron rich isotopes - is correlated with certain neutron star properties.

Using a Bayesian analysis of neutron skin measurements 208Pb, 48Ca and tin isotopes, combined with recent chiral effective field theory predictions of pure neutron matter with statistical errors, we constrain values for the nuclear symmetry energy at nuclear saturation density. Using the posterior distribution of symmetry energy parameters we then model the neutron star crust and obtain the most stringent constraints to date for the location of the crust-core transition and the amount of nuclear "pasta" - non-spherical nuclear geometries - at the base of the crust, from the transition pressure and chemical potential.

The Strength of Nuclear Pasta in Neutron Star Crusts

AMBER STINSON (P), DR. WILLIAM NEWTON — Buried deep within the cooling surface of neutron stars lies a layer of exotic matter. A sea of neutrons, with a scattering of nuclei (clusters of neutrons and protons), fill this region, constantly changing shape and size as the density increases. A way to simulate this is by placing a set amount of neutrons and protons within a unit cell of matter, revealing structures known as "nuclear pasta" – long tubes (spaghetti), slabs (lasagna) or more exotic structures. In the simulations, we can stretch or compress the structures; when stretched beyond a certain point, these structures break. The force required to snap these strands of nuclear pasta tells us how strong the neutron star crust is on a macroscopic scale, which is relevant to whether neutron stars can have "mountains" large enough to generate observable gravitational waves. In this talk we present calculations of the elastic constants of nuclear pasta from our simulations and use them to set upper limits on the shear modulus of the pasta phases assuming their likely anisotropic spatial arrangement. We demonstrate that a commonly used model for the shear modulus in the crust assuming an isotropic crystalline lattice, when extrapolated to the pasta phases, overpredicts the strength of pasta by a factor of at least two, illustrating the pasta is a softer material than a lattice of nuclei.

Fermi-LAT Gamma-Ray Observations — Potential Support for a Multicomponent Dark Matter Scenario

Bailey Tallman (P), Caden LaFontaine, Lexi Boone, Trevor Croteau, Sabrina Hernandez, Quinn Ballard, Spencer Ellis, Noah Maiorino, Roland E. Allen — "There is tension between observations of gamma-ray emission from dwarf spheroidal galaxies, and other sources, and the most natural supersymmetric dark matter candidates. On the other hand, several independent analyses suggest that the observed emissions of gamma rays from the Galactic center are consistent with annihilation of dark matter particles of some kind, with masses somewhat below 100 GeV. We will describe a multicomponent dark matter scenario with a subdominant neutralino and a dominant higgson [1] of mass 72 GeV which is fully consistent with experiment and observation.

[1] Caden LaFontaine, Bailey Tallman, Spencer Ellis, Trevor Croteau, Brandon Torres, Sabrina Hernandez, Diego Cristancho Guerrero, Jessica Jaksik, Drue Lubanski, and Roland E. Allen, "A Dark Matter WIMP That Can Be Detected and Definitively Identified with Currently Planned Experiments", Universe 7, 270 (2021)."

Relic Abundance of a New Dark Matter WIMP Annihilating to WW* and ZZ*

Caden LaFontaine (P), Bailey Tallman, Lexi Boone, Trevor Croteau, Sabrina Hernandez, Quinn Ballard, Spencer Ellis, Noah Maiorino, Roland E. Allen — We report calculations of the annihilation cross-section for the dark matter WIMP that we have proposed, here represented by H. For annihilation to real particles, WW and ZZ, we make the approximation that the W, Z, and H masses are nearly equal (80-100 GeV.). We find that the total annihilation cross-section is more than an order of magnitude too large if the H mass is larger than the W mass. For annihilation to one real particle and one virtual, WW* and ZZ*, we make the approximation of neglecting the masses of the fermions (which are all relatively small). If the H mass is well below the W mass, the total cross-section is more than an order of magnitude too small. As the H mass approaches the W mass from below, however, there is resonant behavior involving the W propagator, and for a mass of 72 GeV the cross-section has the value corresponding to the observed relic abundance.

Direct Detection in a Multicomponent Dark Matter Scenario with Two Coexisting WIMPs (Weakly Interacting Massive Particles)

Lexi Boone (P), Bailey Tallman, Caden LaFontaine, Trevor Croteau, Sabrina Hernandez, Quinn Ballard, Spencer Ellis, Noah Maiorino, Roland E. Allen — The amazing sensitivity of current direct-detection experiments has imposed stringent constraints on any theoretical dark matter candidate. In particular, the most simplistic models with supersymmetry (susy) and weakly interacting massive particles (WIMPs) have been disconfirmed by experiment, and this has led to increasing pessimism about their existence. But there are still quite compelling arguments for susy and WIMPs. Here we discuss a multicomponent dark matter scenario with two WIMPs the neutralino of susy and the higgson of an extended Higgs sector. Both these particles are stable because neither can decay into a set of particles containing the other. We discuss the potential for observing this second particle, which has a mass of 72 GeV, in direct detection experiments such as LZ, Xenon nT, and PandaX-II.

Calculation of the Frequency and Energy of Ordinary Magnets

GH. SALEH (P) — A magnet is a material or object that produces a magnetic field. 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 1015 Hz. Based on Saleh Theory photon is the primary building blocks of the Universe. So the magnetic fluxes also should make of that. Relative to penetrability of magnetic fields and its special and beautiful state, it can be said that magnetic waves are not single photons. Rather, they are a group of photons that are joined together in a chained state.

In this paper to calculate the frequency and energy of the magnets, we have used a simple experiment. By using this experiment, we obtained the energy and frequency equations for the ordinary magnets.

Optical, Molecular, and Atomic

Parallel Session 8 – Saturday Mar. 12, 10:15-11:30 – HWC B

Mechanisms for Enhanced Hopper Flow Rate from a Hopper with an Obstacle

MICHAEL C. HOLCOMB (P), GUO-JIE JASON GAO, FU-LING YANG; JERZY BLAWZDZIEWICZ — The flow rate of granular particles through a hopper can be enhanced through proper placement of an obstacle in the hopper. An optimally placed obstacle produces a flow rate enhancement by channeling the maximum number of particles that can smoothly merge towards the exit. If the obstacle is placed too far from the exit, so many particles are channeled that the chance of congestion at the exit increases. If the obstacle is placed too close to the exit, so few particles pass that the overall flow rate is reduced. Using a novel modeling technique inspired by the puzzle game Tetris that simplifies the complications of interparticle forces, we show that the flow rate peak phenomenon can be created in two other ways. One, by artificially guiding the particles towards the midline of the free space beneath the hopper, and the other by narrowing the hopper exit angle below the obstacle. Enhancing the flow rate of granular particles through a hopper is an important engineering question. We expect that these results can be used to improve hopper design and will have broad industrial applications.

Detailed Force Fields of Non-Magnetic Body-Centered Cubic Iron with Thermal Disorder

ADRIAN DE LA ROCHA (P), VALERIA ARTEAGA, SOFIA GOMEZ, YU-HANG TANG, WIBE A DE JONG, JORGE A MUNOZ — Gaussian process regression on a molecular graph kernel (Tang, 2019) was performed to construct a relation between the total potential and atom displacements of a non-spin-polarized BCC iron (Fe) ab initio simulation. When training on 400 randomly selected molecular dynamics steps, the standard deviation of errors in the testing predictions of the model was of 8meV, while the mean of this errors was 5meV. The resulting machine learning potential of a model trained on 1000 time steps was used to approximate the forces acting upon each atom in the axes of displacement of each first and second nearest-neighbor. The forces were obtained through numerical differentiation according to the central difference approximation and through derivation of a polynomial fit to the potential functional given by the model. The resulting forces are consistent within approximation techniques and show stability in the second nearest-neighbors' axes, but not for the first nearest neighbors. While it is known that the BCC is unstable without magnetism (Heine, 2019), these observations suggest that the effect of magnetism in the stability of the system of interest is not noticeably affected in the second nearest-neighbor interactions.

Dipole Transition Calculations between Hydrogen Quantum States

EMILY MAXEY (P), EDDIE HOLIK — The hydrogen atom can be described by a quantum wave function, unique to its specific combination of principle, angular, and projection quantum numbers. When some energy such as an electric or magnetic dipole field or the absorption of a photon perturbs this wave function, it allows the atom to transition into a different quantum state. The probability of such a transition is defined by the integrated overlap between the wave functions of the initial and final states. Generalized wave functions were coded in C++ as well as integration functions using Sampson's method. Various transition probabilities were systematically calculated using the code and compared to expected integration results. Code design and output will be presented along with a comparison to expected values. A final comparison to experimental transition rate measurements will also be presented.

Design and Fabrication of a Tesla Coil Speaker

ALBERTO DIAZ HERNANDEZ (P), EDDIE F. HOLIK — A novel tesla coil was designed and built to modulate very high voltages at radio frequencies. The modulation frequency is in the audible range and enables the tesla coil to reproduce sound like a speaker. The design consists of a dual-tuned resonant transformer that uses a large power triode transmitting tube to continuously drive the transformer at its resonant frequency. This driving frequency can be modulated by a 3.5 mm audio jack external signal to control the waveform of the high voltage output. Construction of the required atypical power supplies was focused on using commonly available materials as much as possible. Voltage and oscilloscope measurements will also be presented along with possible design improvements.

Coupling Two Lasers on a Crown Glass Surface

CRISTIAN BAHRIM (P), RISHI BHARADWAJ — We show experimental results for locking a probe laser in the vibrations of dipoles on a dielectric surface through destructive interference triggered by a stronger coupling laser which simultaneously irradiates the same dipoles. Our measurements are based on reflecting a weak laser beam by a crown glass surface within 12 degrees of its Brewster angle (which is about 56.6 degrees), assisted by a stronger coupling laser oriented perpendicular to the surface. The region of interaction between laser beams on the glass surface is 2mm wide. We consider both the case of a probe laser of lower frequency (650 nm), as well as of same frequency (532 nm) with the coupling laser, which has a fixed 532 nm wavelength. In the case where the lasers are different, the stronger coupling laser imposes its frequency to the dipoles of silicon on the glass. This inhibits the probe laser which shows a large Brewster region of about 2 degrees, with negligible reflectivity. Outside Brewster region, the coupling laser inhibits the probe near 59 degrees. When the coupling laser is assisted by a weak electric field oriented along the surface (produced by two metal plates which hold the crown glass' surface), the deep in the reflectance at 59 degrees gets shallower due to the additional energy from this field, which is transferred to the dipoles on the surface. When the energy from the E-field increases even more, this deep shifts in position. For two lasers of same frequency, the EIT conditions are met, and therefore, the probe and coupling lasers interfere showing a pattern with an almost even distribution of maxima and minima. As the electric field oriented along the surface increases in magnitude, the interference pattern is compromised by electric dipoles' vibration. This research offers a solution for storage of energy on surfaces.

New Generation of Sensitizers for Photodynamic Therapy – Deeper and Better

WEI CHEN (P) — Photodynamic therapy is a combination of light and sensitizers for cancer treatment. The sensitizers and the light are non-toxic but when they interact each other toxins like reactive oxygen species are generated that can kill cancer cells. Photodynamic therapy has the beauty of targeting tumors by the sensitizers themselves and the light, so its side-effect is much lower than chemotherapy or radiotherapy. However, the need of light for activation has some limitations as light cannot penetrate deeply into tissue, so photodynamic therapy has been widely used for skin disease treatment but not for deep cancer treatment. In this webinar, I will discuss the possible solutions for developing photodynamic therapy for deep cancer treatment and some new progress in Photodynamic therapy and the invention of new sensitizers that can be activated by UV, X-ray, microwave and ultrasound to produce reactive oxygen species for deep cancer treatment as well as immunity enhancement. New ideas for the combination of photodynamic therapy and radiation to overcome radiation resistance will be discussed.

SPS Session I

Parallel Session 1 – Friday Mar. 11, 10:45-12:15 – HWC A

Numerical Study of Liquid Films in the External Field of a Wetting Substrate Using Density Functional Theory for 2D Lattice Gas with Short-Range Interactions

AUSTIN BRIDWELL, **KENNETH STOKES (P)** — The method of density functional theory (DFT) was used to study density profiles of nonuniform liquid and vapor on a wetting substrate in the case of complete wetting. The DFT model was based on a 2D lattice structure with short-range interactions. Closest and second closest neighbor interactions were included. Iterative numerical procedure was used to solve DFT equation for the density profile of liquid films. Low (close to spinodal) and high (close to binodal) values for chemical potential at constant temperature below critical point were considered to simulate liquid films of various thickness. Disjoining pressure for those films were then found. It has been shown that the disjoining pressure decays with increasing thickness. It follows an exponential decay pattern for thin liquid films and an inverse cubic pattern for thick liquid films.

A Network Model for COVID-19

NOAH POPE (P) — To eradicate a virus such as COVID-19, there is a threshold percentage of the population that needs to be vaccinated. This paper describes a model that was created to find the fraction of people needed to be vaccinated for effective population immunity or “herd” immunity. A network model will be used to model the spread of COVID-19 across the United States. Each node in the network will be modeled using an SEIRS model. The model will use spatial data to model the connectedness of different parts of the country. We explore how the herd immunity threshold depends on several epidemiological parameters such as infectivity, asymptomatic fraction, connectedness of populations, and vaccine effectiveness. We will simulate different social responses such as mask mandates and lockdowns by adjusting the infectivity and connectedness parameters. We will present the status of these simulations and any results we have found. This paper is significant because understanding these behaviors will allow public health officials to make more informed decisions when responding to future changes of COVID-19. This model accomplishes this by allowing for different parameters for the virus that will give a range of how many people need to be vaccinated depending on the strain of the virus that is dominant.

A Model of the Impacts of Drug Resistance in an Influenza Epidemic

ELIZABETH JENNINGS (P) — Influenza viruses annually cause high morbidity and mortality among vulnerable populations. These viruses are constantly changing, and thus developing updated vaccines and treatments to combat them is vital. The emergence of drug-resistant strains of influenza has posed a great challenge in effectively combating the spread of this disease. Thus, the dangers of the rise of drug resistant viruses must be considered before any large-scale implementation of drug treatment during a major outbreak. This paper presents a mathematical model, composed of many individual systems of coupled nonlinear ordinary differential equations (similar in structure to the Kermack-Mckendrick model) which are then linked together to form a greater network. This model is being created with the goal of illustrating the transmission dynamics for a wild-type (non-resistant) influenza strain and the spread of a resistant strain in response to various treatment strategies. The current status of this work will be presented.

Tracking Cells of a Developing Embryo with PyEDGE

TROY LONG (P), MICHAEL HOLCOMB — The ability to identify and track cells of a developing embryo is an important tool for biophysics groups exploring inter-cellular signaling. The Embryo Development Geometry Explorer (EDGE) is a software tool developed by Gelbart et al. (2012) using MATLAB that analyzes time-lapse microscopy images of developing embryos. PyEDGE is a pythonic re-implementation of EDGE, created from the ground up to improve speed, accuracy, stability, maintainability, modularity, and accessibility. In particular the PyEDGE package provides modular image processing and cell filtering, along with Pandas database support.

Passive Radar for Meteor Detection

NATE ROWLANDS (P), LARRY ISENHOWER — NASA's SHAARC group uses radar to make scientific observations of celestial objects. Meteors burning up in the upper atmosphere contribute to the noise in these observations leading to interference in their data. To overcome this issue, we are developing a system to detect and track the trajectories of these meteor events using passive radar techniques. FM radio stations will act as the radio frequency source and signals from these stations will reflect off the meteor trails and be picked up by our antenna. The signal will be processed through an FPGA and a convolution signal processing algorithm to determine meteor events. These events can be used to study the signal profiles of meteor events and it is hoped this knowledge will allow the SHAARC group to make better measurements. The antenna system and FPGA hardware required to capture these signals will be presented in this talk.

Design and Optimization of a Linear Magnetic Accelerator

NICHOLAS SWARTZ (P) — Advances in battery and capacitor technology within the past decade have made the use of electrical energy for transportation and propulsion more viable. One method of electrical propulsion uses an electromagnetic phenomenon called the Lorentz Force, whereby an object within a strong magnetic field can be accelerated by driving electrical current across it. A python computer program was written to solve the coupled differential equations for projectile acceleration, current, and induced voltage of a rail gun. The final velocity is calculated based on projectile mass, magnetic field, capacitance, rail geometry, voltage, and resistance as input parameters. A small prototype rail and projectile was fabricated and characterized to verify the computer program and for use in physics outreach demonstrations. The key python code features will be presented along with prototype output measurements. A comparison between the theory and experiment will be presented along with plans for a refined rail gun design.

A Pedagogical Approach to Relativity Effects in Quantum Mechanics

LUIS GRAVE DE PERALTA, KATRINA. C. WEBB (P) — A simple but precise approach to relativistic quantum mechanics is presented. The approach is based on the use of a Schrödinger-like, little-known but well-studied quantum mechanics wave equation. Such formal similitude allows undergraduate students to quantitatively explore how the results corresponding to a typical non-relativistic quantum problem change when the particle is moving at relativistic speeds. No additional mathematical skills are required. We argue in favor of the academic use of this approach for including the implications of the special theory of relativity in introductory quantum mechanics courses.

SPS Session II

Parallel Session 7 – Saturday Mar. 12, 10:15-11:30 – HWC A

Quantifying the Uncertainty on the Location of the Holographic Critical Point

MICHAEL TRUJILLO (P), JOAQUIN GREFA, ISRAEL PORTILLO, CLAUDIA RATTI, JORGE NORONHA, JACQUELYN NORONHA-HOSTLER, MAURICIO HIPPERT, ROMULO ROUGEMONT — In Quantum Chromodynamics (QCD), we study the behavior of strongly interacting matter made up of quarks and gluons. The transition between the confined and low-energy phase called hadron gas and the deconfined and hot quark gluon plasma phase is a smooth crossover at vanishing density. However, it has been conjectured the crossover must evolve into a line of first order phase transition with a critical end point. By using an Einstein-Maxwell-Dilaton (EMD) model, fixed to reproduce the Lattice-QCD equation of state at vanishing chemical potential, we predict the location of a critical end point in the phase diagram. Two free functions in the EMD model are fixed to reproduce the lattice equation of state, a scalar dilation potential, and another corresponding to the coupling between the Maxwell and dilation fields. By modifying these free functions, we study a possible change in the predicted location of the critical point in the phase diagram.

Effect of Resonance Decays on Net-Kaon Fluctuations

JONATHAN GONZALES (P), CLAUDIA RATTI, JAMIE KARTHEIN — We compare the mean-over-variance ratio of the net-Kaon distribution calculated with a hadron resonance gas model to the experimental data from the STAR collaboration.

The theoretical ratios are calculated through Monte Carlo simulations, to best capture the probabilistic nature of particle decays. Freeze-out parameters previously obtained in the literature are used as inputs. By comparing our results to the experimental data, we are able to quantify the effect of probabilistic resonance decays.

A Theoretical Calculation of the Rho's Unitarity Cut at Nonzero Momentum

NOAH MITCHELL (P), JOSEPH ATCHISON, JOSHUA NICHOLSON — In the realm of particle physics, there are still many mysteries left to uncover. One such mystery is how particles behave in hot and dense nuclear matter. To better understand the way particles operate under these conditions, we use theoretical models to predict their behavior, such as calculating Feynman diagrams under different momenta. This project extends work on pion conductivity from Dr. Atchinson's thesis, except we will be calculating our values at a finite temperature and momenta to predict results that would be achievable experimentally. This will allow us to then check the validity of certain pre-existing models of meson behavior at lower energies by comparing our theoretical models with overall predictions made by general ones. We also plan to check if at high enough temperature we have a change in not only the conductivity, but also in the mass of the rho.

Theoretical Calculation of the Electric Conductivity in a Dense Pion Medium

JOSHUA NICHOLSON (P), JOSEPH ATCHISON, NOAH MITCHELL — The theoretical study of the fundamental particles is vital in our understanding of their interactions within a hot and dense nuclear matter. Properties of these particles can be calculated from theoretical models that can be connected to experimental measurements from heavy ion collisions (HIC) at the Large Hadron Collider (LHC), and the Relativistic Heavy Ion Collider (RHIC) where temperatures are high enough to create quark gluon plasma (QGP) on the order of trillions of degrees. Using the methods of Quantum Chromo Dynamics (QCD) and Quantum Electro Dynamics (QED) in the realm of high energies, the theoretical calculations may be used to probe the hot and dense pion bath created by these experiments and by the early universe. We will use Feynman diagrams to calculate the pion, rho, and sigma's self-energy from the Landau cut to access the electric conductivity. From these calculations a better understanding of quark confinement, mass generation, and chiral symmetry breaking may be gained, and a deeper knowledge of matter and the strong force can be achieved.

Applying the DUNE CVN Event Selection to ICARUS Data

EDUARDO DAGNINO (P), DANIEL CHERDACK, ANTONI ADUSZKIEWICZ — Neutrinos can be used to study fundamental aspects of the universe and give us insight into many big questions in physics. One of the most interesting properties of neutrinos is that the description of neutrinos that interact (flavor states) is different from the description of neutrinos that traverse time and space (mass states). Most neutrino experiments work to understand some aspect of the relationship between these two descriptions. To study these properties, we need to understand the flux, or how many neutrinos go through our detectors, and how those neutrinos interact with our detectors through their interaction rates. ICARUS is a 430 t liquid argon neutrino detector located at Fermi National Accelerator Laboratory and serves as the far detector for the Short Baseline Neutrino program. The ICARUS detector lies 795 m downstream and 5.7° above the Neutrinos at the Main Injector (NuMI) neutrino beam. At this large off-axis angle, ICARUS poses a unique opportunity to measure a variety of electron and muon (anti-)neutrino interaction rates with argon nuclei, which will be an important input to the Deep Underground Neutrino Experiment (DUNE).

Computer scientists working in collaboration with High-Energy physicists have developed a Convolutional Neural Network (CVN) for the DUNE collaboration in the hopes of achieving highly efficient and pure selections of electron neutrino and muon neutrino Charged-Current (CC) interactions. The CVN's excellent performance with Monte Carlo simulations, coupled with its generalizability, should hypothetically allow for the retooling of the network for use with ICARUS data. After formatting the images to work with ICARUS data, we should be able to test the effectiveness of the network with ICARUS data, validating the conclusions of the DUNE collaboration analysis as well as providing a powerful tool for the ICARUS event selection.

Development of Optical Tweezer Demonstration

ERIC JI (P) — The optical tweezer is an important phenomenon that is used in several scientific fields. An explanation for the optical tweezer will be presented using conservation of momentum with GeoGebra. An optical tweezer demonstration was developed where several different size of diamond powders were tested from 1 to 10 microns. Different power and laser wavelengths were tested along with different environments for the powder. The final product is a fully enclosed 3D printed casing with sooted copper base plate and cover slit on all sides to minimize air turbulence. The phenomena will also be demonstrated by picking up a diamond powder with size of 1 micron with 250mW 650nm laser coupled to a 18mm diopter focusing lens.

Posters

Friday Mar. 11, 15:00-17:00 – HWC Lobby

Electrostatic Charge Mitigation in Shadowed Regions of the Moon

ROBERT SAMUDIO (P), TARYN FAMBROUGH (P), JACOB WILLIAMS, JONATHAN SAMUDIO, JOSEPH WATSON, AUSTIN BRIDWELL — This project studied various methods of charge dissipation for possible use on spacesuits during the Artemis missions. The two methods examined were the use of flexible conducting spikes and vaporization of polar molecules from a charged surface. Each solution was tested in atmosphere and under medium vacuum of between 100 and 500 mTorr, with Van de Graaff generators used to deposit charge. Funding from the NASA MINDS Program was used purchase materials for testing, and to refurbish the McMurry University bell-jar vacuum chamber. Both the active and passive methods of charge dissipation were found to be effective under vacuum, with a copper weave triangle producing the best results for the passive case. In the active case, vaporizing polar molecules is highly effective, however further considerations would need to be made in regards to functionality in the lunar environment due to ice formation from evaporative cooling.

Watershed Image Analysis Using OpenCV's Python Package

TROY LONG (P), MICHAEL HOLCOMB — Cellular imaging is inherently affected by low signal-to-noise ratios. Watershed analysis is a well established tool for identifying individual cells in confocal microscopy images; however, it requires pre-processing of input images for high-quality results. PyEDGE leverages the OpenCV library for watershed analysis and bilateral filtering. This presentation will discuss the Python extension of OpenCV as a tool to effectively use watershed analysis in the context of cellular imaging.

Computational Design of Materials Via Convolutional Neural Networks

EDWIN TOMY GEORGE (P), JORGE MUNOZ, OLAC FUENTES — The phase diagram is a type of chart used to show the conditions at which thermodynamically distinct phases occur and coexist at equilibrium. In the case of alloys, these phases include the liquid stage and the different solid crystal structures that the alloy can be found depending on the temperature and percentage mixture of each metal. Determining a phase diagram is done experimentally, which is extremely expensive in terms of time and resources. We propose using a machine learning model to obtain phase diagrams of alloys. We use convolutional neural networks (CNN) since they are space invariant. The alloy of Copper (Cu) and Silver (Ag) were used to train the CNN model, since the Cu-Ag phase diagram is readily available, serving as a comparison for the CNN’s predictions. Molecular dynamic simulations of the alloys in different conditions were used to generate the data in the form of cartesian coordinates of the atoms and the total potential energy of the system. The cartesian coordinates were transformed to a set of symmetry function values which served as an input for the model. The CNN model is trained on the symmetry function values as input and predicts the potential energy of the system. From the potential energy of an alloy at different conditions, a phase diagram can be derived.

Nuclear Excitation Energies in the Context of Space Radiation: Carbon, Nitrogen, and Oxygen

J. WOTE (P), G. ERICKSON, X. HU, AND P. SAGANTI — Space radiation consists of protons (85%), alpha particles (14%) and about 1% heavy ions typically from Li (Z=3) through Ni (Z=28). However, of these 1% particles, some of them contribute significant dose than the more abundant protons and alpha particles particularly to space travelers those who travel to Low Earth Orbit and beyond. Of the several heavy ions, in this study, we present space measurements of Carbon (C, Z=6), Nitrogen (N, Z=7), and Oxygen (O, Z=8), the so-called C-N-O abundances in space environment. We also analyzed recent published nuclear excitation energy values for the C-N-O nuclei. We present our analysis of nuclear excitation energies in the context of dose contributions.

Equations of State of a Magnetized Quark Matter Phase at Intermediate Baryon Density

YARITZA VILLARREAL (P), JOCELYN RICH (P), EFRAIN J FERRER — We present the equations of state of a dense quark matter phase known as the magnetic dual chiral density wave, considering the asymmetry created in the stress-energy tensor by a magnetic field. The longitudinal and transverse pressures, the energy density, magnetization and quark number density are all found as functions of the magnetic field, temperature and baryon density. Our results are important to investigate the inner structure of neutron stars as well as for applications to heavy-ion collision experiments.

The Angular Dependence of Cosmic Rays

GARATH VETTERS (P), ALEXANDRA VISHNEVSKAYA, YOUNGSANG "ERIC" JI, KENNETH CARRELL — Through the use of two scintillation detectors connected in series, the count rates of charged particles were measured as a function of the angle from vertical. We will present the construction and testing of the experimental apparatus, the results from this experiment, as well as the theoretical explanation for the angular dependence of the detection rate.

A New Composite of 1,4-bis(5-phenyloxazol-2-yl) Benzene and Aggregation-induced Emission Luminogens for White Light-Emitting Diodes

ERIC AMADOR (P), AKHIL RK. KALAPALA, GEORGE BELEV, JEOTIKANTA MOHAPATRA, NIL PANDEY, RAMASWAMI SAMMYNAIKEN, PING LIU, WEIDONG ZHOU, AND WEI CHEN — As the standards for white light emitting diodes become higher and higher, research is being done to test out different sources of white light to improve the lighting and their appliances. Here we show that it is possible to use an organic scintillator in the blue region (POPOP) and a red emitting Pyridinium based aggregation induced emission luminogens (TPEPY-PF6) complex which when illuminated by UV light, emits white luminescence. This mixture of both luminescent materials when placed onto a polymer matrix on top of a UV LED chip can produce an efficient white light source which is good for white LED applications. The advantages presented here are that the luminescent PMMA contains no expensive metals but only low-cost organic materials with a measured absolute quantum yield of 53.71%, which is promising for practical applications.

Abraham Summation Solute Hydrogen Bonding Acidity Values Determined for Catechol-Flavones by 1H-NMR Spectroscopy

TARYN GIBBS (P), WILLIAM L. WHALEY, SARA TUCK, MARCUS GREGORY, MICHAEL H. ABRAHAM — There is evidence supporting the potential use of catechol-flavones for the treatment of neurological diseases such as Alzheimer's disease, Huntington's disease, Parkinson's disease and amyotropic lateral sclerosis. The compound 7,8-dihydroxyflavone has shown efficacy in laboratory models for each of these conditions. The catechol group is known to confer free radical scavenging activity, binding to divalent cations, and may be important for binding to certain proteins such as amyloid beta peptide. For treatment of brain disorders, these compounds must be efficiently absorbed into the blood stream and translocated across the blood-brain barrier. The logarithm of the 1-octanol/water partition coefficient (LogP) is the most commonly used descriptor for predicting absorption, delivery, metabolism and excretion (ADME) properties. LogP for flavonoids can be calculated from the Abraham general solvation equation (AGSE) if certain measured parameters, such as the summation solute hydrogen bonding acidity (A), are known. The values of A for the mono-hydroxyflavones and mono-hydroxyisoflavones have previously been reported by this research group. For catechol (ortho-dihydroxy) groups, there is reciprocal intramolecular hydrogen bonding (IMHB) that diminishes the value of A for each hydroxyl group. For flavonoids, there is another complication due to IMHB between a hydroxyl group and the position 4 carbonyl group or the position 1 oxygen atom. The value of A was estimated by measuring the 1H-NMR chemical shift difference for the hydroxyl groups in DMSO-d6 versus CDCl3. The compound 5,6-dihydroxyflavone was sufficiently soluble in both solvents to determine the overall value of A as 0.56, which is lower than for catechol. All other catechol-flavones were insoluble in CDCl3. An alternative approach using flavonoids with a methoxy group ortho to a hydroxyl group was used to estimate the values of A for the other catechol flavones. These values of A were then used to calculate LogP values by the AGSE.

Nuclear Excitation Energies in the Context of Space Radiation: Silicon and Iron

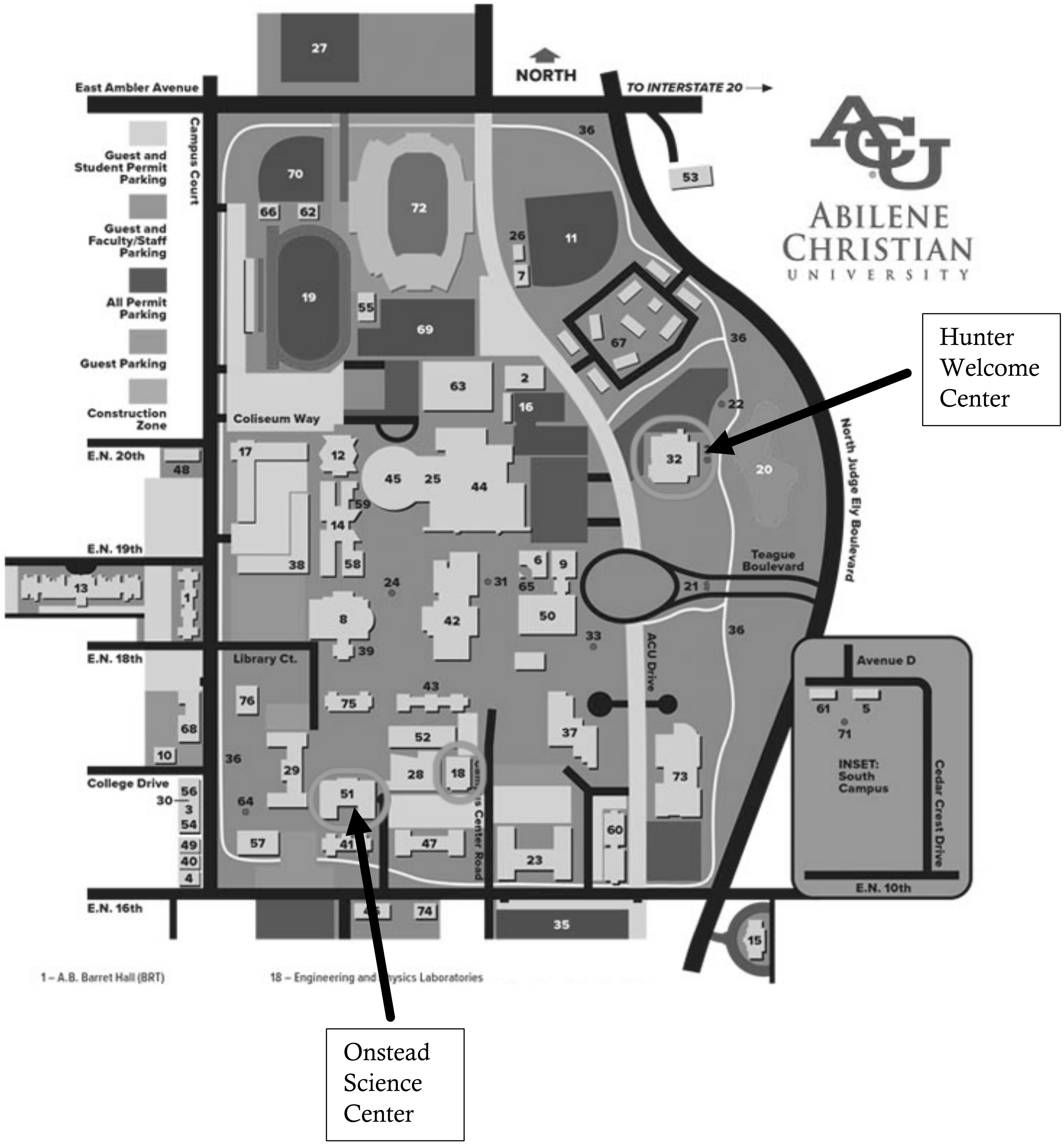
S. WOBOGO (P), G. ERICKSON, X. HU, AND P. SAGANTI — Space radiation consists of protons (85%), alpha particles (14%) and about 1% heavy ions typically from Li (Z=3) through Ni (Z=28). However, of these 1% particles, some of them contribute significant dose than the more abundant protons and alpha particles particularly to space travelers those who travel to Low Earth Orbit and beyond. Of the several heavy ions, in this study, we present space measurements of Silicon (Si, Z=14) and Iron (Fe, Z=26) the so-called Si-Fe abundances in space environment. We also analyzed recent published nuclear excitation energy values for the Si and Fe nuclei. We present our analysis of nuclear excitation energies in the context of dose contributions.

Comparing the Thermal Degradation of ZDDP and Tributylmethylphosphonium dimethylphosphate using P-31 NMR Techniques

FRANCISCO FUENTES (P); JONATHAN HEIDEMA; SCOTT WILLIAMS; SARAVANAN RAMASAMY — Zinc dialkyldithiophosphate (ZDDP) is a widely used anti-wear oil additive that has been shown to harm catalytic converters and the environment in general. One alternative is tributylmethylphosphonium dimethylphosphate (PP), which has been found to have superior anti-wear properties under some conditions. We have heated ZDDP and PP samples for various lengths of time to temperatures up to 200ºC. The thermal degradations have been compared by utilizing phosphorus-31 nuclear magnetic resonance techniques.

An Analysis of a Previously Unknown Binary System in the Constellation of Auriga

Jackie Gray Cherry (P); Kenneth Carrell — Using a crossmatched catalog of potentially variable sources, we have analyzed Transiting Exoplanet Survey Satellite (TESS) data in an attempt to verify variability of selected targets. We discovered 4 binary systems, one of which is known, and the other 3 are unknown. One of these systems had 2 distinct eclipsing events, and because of the large pixel size for TESS, follow-up observations of this target were necessary. Target selection, TESS analysis, and results from the follow-up observations will be presented.



Parking for the Friday and Saturday events at the Hunter Welcome Center should be available in the lot adjacent to the building or along ACU Drive used to get there.

Parking for Thursday evening events and workshops at the Onstead Science Center may be available in the lots adjacent to the building or in the large lot at University Church of Christ across EN 16th St.