2018 Annual Spring Meeting of the APS Ohio-Region Section and the AAPT Michigan Section
East Lansing, Michigan
http://www.aps.org/meetings/meeting.cfm?name=OSS18
Spectroscopic Study of Variable Hydrogen Line Emission in Be Stars, ELIJAH LUPARDUS, CRAIG HOWALD, ANN BRAGG, Marietta College — This senior project uses a spectrometer built by previous Marietta College seniors to study Be stars, which are characterized by variable emission in their hydrogen lines. The spectrometer is attached to a 16 inch reflecting telescope and raw images are obtained using the Artemis CAPTURE program. A Python program was created to translate these images into spectra and to quantify the amount of emission or absorption in the hydrogen lines. We will present spectra of omicron Cassiopeia, reflecting telescope and raw images are obtained using the Artemis CAPTURE program. A Python program was created to translate these images into spectra and to quantify the amount of emission or absorption in the hydrogen lines. We will present spectra of omicron Cassiopeia, revealing that the emission is variable over time.

B.00002 Two-Dimensional Mapping of Non-Linear Emission from Superconducting Devices, ANNA WORMMEESTER, STEPHEN REMILLARD, Hope College — Superconducting devices distort signals because of the nonlinear response of the superconductors to the signal current. Multiple signals will mix, generating local intermodulation tones which enable a nondispersive investigation into superconductor nonlinearity. In this work, local points of signal distortion in a superconducting device are detected by a raster probe, which generates an image of the nonlinearity throughout the device, and highlights distortion hotspots. This gives engineers a better sense of the limitations in a device design and gives physicists insight into the intrinsic and extrinsic causes of nonlinearity. A distortion raster scan was made using a wide linewidth folded superconducting YBa2Cu3Oy structure. Refinements in the probe design improved the resolution to less than 250 μm allowing narrow linewidth devices to be imaged. Besides device characterization, this method is being used to investigate the superconducting device physics. As an example, the influence of magnetic fluxons on the nonlinear distortion will be described.

B.00003 Assessment of non-local similarity methods for electron microscopy image denoising, PETRU FODOR, Cleveland State University, ALINA LAZAR, Youngstown State University — Electron microscopy imaging has been one of the critical material characterization tools, when very high spatial resolution is required. However, when the electron doses used have to be kept small due to the possibility of sample damage or to speed-up the acquisition process, the image quality tends to be poor. This is due to both the typically low signal levels, as well as the complex noise profile associated with this type of instrumentation. In this work we explore the use of state-of-the-art image reconstruction techniques based on exploiting non-local similarities in the acquired images to extract high quality data from low electron exposure acquisitions. The viability of the methods is evaluated by comparing reconstructed results from noisy images acquired at low electron doses with imaging data obtained at high electron doses (i.e. with high signal-to-noise-ratios). The assessment is based both on standard image processing analysis measures, such as peak-signal-to-noise-ratios (PSNR), as well as the ability of automatic algorithms to extract the features of interest from denoised images. Our results indicate that this type of post-processing is a viable strategy to improve feature recognition from noisy electron microscopy image data.

B.00004 Automated Characterization of Fluxon Electrodynamics in a Superconducting Microwave Device, ALEXANDER MEDEMA, STEPHEN REMILLARD, Hope College — Superconducting electronic resonators serve a wide variety of industrial and scientific applications such as MRI receiver coils and wireless transceiver filters. Characterization of fluxon electrodynamics in these devices allows for better understanding of the physical properties of superconductors and improvements to the design of cellular networking components by providing insight into how superconductors distort signals. Signal mixing through intermodulation distortion (IMD) is affected by the flow of supercurrent around fluxons modulated by the Meissner Effect. The Hope College Microwave Group has developed a method to measure the time relaxation of radio signal mixing in superconducting circuits upon the removal of an applied magnetic field. The automation in this project increased the measurement rate by two orders of magnitude revealing a previously undetectable fast process during the first second of relaxation. This work will contribute to the understanding of fluxon dynamics in superconductors and its role in signal distortion. This material is based upon work supported by the National Science Foundation under Grant Number DMR-1505617.

B.00005 Electric Fields of 2-Dimensional Current Carrying Surfaces, NIKHIL WATS, BRETT BOLEN, BEN HOLDER, Grand Valley State Univ — The equations of electromagnetism describe how electric fields are produced by charge distributions in 3D space and how electric fields drive current in matter. If current is constrained to a 2D surface, the driving electric field effectively becomes a 2D field. By studying these 2D fields, we find that they have different properties than their 3D counterparts. For example, electric field strength of a point source is inversely proportional to radius in a 2D field, whereas it is inversely proportional to the radius squared in 3D fields. Moreover, the relationship between field strength and radius is depends on the spatial curvature of the surface. Therefore, with 2D analogs, we can study the influence of spatial curvature on effective field strength. In this project, we theoretically and experimentally study electric fields driving current on flat, conical, and spherical surfaces in order to evaluate the effect of curvature on field strength.
B1.00006 Tests Of Shrouded Wind Turbines In A Wind Tunnel. THOMAS KORDA, DENNIS KUHL, Marietta College — It has been predicted that a flanged shroud around a horizontal axis wind turbine will significantly enhance the production of electricity by the turbine. To test this, wind tunnel experiments were performed at three different air speeds with a model turbine positioned at the center of the test section. The air pressure in front of and behind the model turbine was measured, and the speed of the turbine was monitored by recording the voltage produced as the turbine turned. Preliminary measurements show that the presence of a shroud does increase the air flow through the turbine. Future work will test multiple designs to investigate what shroud and flange characteristics most contribute to the improvement.

B1.00007 Electrical properties of Mo/SiC Schottky barrier diodes. SAI BHARGAV NAREDLA, TOM ODER, Youngstown State University — Molybdenum has been recognized as a refractory metal suitable for high temperature applications. It has been used as a barrier material in processing silicon carbide devices. In this investigation, molybdenum Schottky contacts were deposited on SiC at different temperatures ranging from 26 °C to 900 °C using dc magnetron sputtering. The electrical properties of the Schottky barrier diodes were characterized using current-voltage, capacitance-voltage and current-voltage-temperature measurements. The as-deposited diodes exhibited ideality factor varying from 1.03 to 1.71 and barrier height ranging from 1.04 to 1.58 eV. Additional results from the characterization will be provided in this presentation.

B1.00008 Probing Phase Transitions in Ceramic Nanofibers. NENAD STOJILOVIC, University of Wisconsin Oshkosh — In this study we employ sol-gel and electrospinning methods, followed by annealing at different temperatures, in order to produce ceramic titania and alumina nanofibers. Titania nanofibers display anatase, rutile and anatase-rutile structures, and we make an attempt to better understand complex competition of these phases during annealing process. Alumina nanofibers, due to the coexistence of various structural phases with overlapping Bragg’s peaks, are especially challenging to study using X-ray diffraction method. With the goal to better understand crystal phase formations and transitions in these nanofibers, and to ultimately produce materials with desired crystal structures, we vary annealing temperatures and heating rates and perform measurements using powder X-ray diffraction (XRD), scanning electron microscopy (SEM), and X-ray energy dispersive spectroscopy (XEDS).

B1.00009 Study Of Electron Traps In β-Ga2O3 Single Crystals Using Thermoluminescence Spectroscopy. MD MINHAZUL ISLAM, DHAN RANA, ARMANDO HERNANDEZ, FARIDA SELIM, Bowling Green State Uni — The presence of electronic defects in Gallium oxide (Ga2O3) single crystals greatly affects the transport of electrons and excitons. The origin of these electronic defects could be the anion/cation vacancies or the incorporation of impurities into the crystals during the growth process. The defects can act as electron traps that can affect the optical and electrical properties of Ga2O3 crystals by introducing intermediate energy levels in the bandgap. Identification of the nature of the defects is crucial for the successful application of β-Ga2O3 in optoelectronics. Shallow and deep trap levels associated with oxygen vacancies and iron impurities in doped (Mg-doped, Fe-doped, Sn-doped) and undoped β-Ga2O3 single crystals were studied using temperature and wavelength resolved thermoluminescence spectroscopy. Thermal activation energies of trap levels have been calculated using multiple heating rates and/or initial rise method depending on the kinetics and suitability. Ultraviolet to visible (UV-VIS) spectroscopy was performed on the samples to determine the bandgap (~4.51 eV) that did not show any significant change due to the incorporation of dopants. Hall effect measurements were carried out at room temperature to determine the electrical parameters.

B1.00010 Characterization Of Defects In β- Ga2O3 Thin Film Grown By Metal Organic Chemical Vapor Deposition. ARMANDO HERNANDEZ, SAHIL AGARWAL, DAVID WINARSKI, POONEH SAA-DATKIA, FARIDA SELIM, BGSU — β—Gallium(III)oxide (Ga2O3) emerging as a semiconducting material of great interest for fabrication and advancement of high powered devices because of its very wide bandgap, excellent electrical properties and high breakdown voltage. In this work, epitaxial films of as-grown and Si doped β-Ga2O3 were fabricated by Metalorganic Chemical Vapor Deposition (MOCVD) and were characterized by X-Ray Diffraction (XRD), Thermoluminescence (TL) and Hall Effect measurements. The XRD patterns revealed formation of pure epitaxial β-Ga2O3 phase. Luminescence was recorded in the range of 200-800nm using TL between -190 °C to 360 °C to detect all emission centers. An electron trap was identified at very low temperatures. Electrical properties including resistivity, density and mobility were determined using Hall Effect measurements. This study illustrates an efficient method to grow pure epitaxial β-Ga2O3 as well as identify its fundamental properties and investigate the role of defects.

B1.00011 Effects Of Dopants on the Electrical Transport Properties of Czochralski (CZ) and Edge-Defined Film-FED (EFG) Growth Grown β-Ga2O3. DHAN RANA, Bowling Green State Univ, POONEH SAADATKIA, SAHIL AGARWAL, FARIDA SELIM, Bowling Green State University — Gallium oxide (Ga2O3) is the widest band gap (4.8-5.0 eV) semiconducting oxide known so far transparent up to UV-C range. Due to wide band gap and high Baliga’s Figure of Merit (FOM), it possesses excellent material properties for high power device applications. It exists in five different polymorphs (α, β, γ, δ and γ'), with β being the most stable at all temperatures. Electrical transport properties of Czochralski (CZ) grown and Edge-Defined Film-Fed Growth (EFG) grown samples were evaluated by using Hall effect and Van der Pauw techniques. The conductivity of samples was found to be highly dependent on doping material. Un-doped β-Ga2O3 single crystal is highly resistive (1012 &ohm;cm), but the Sn-doped β-Ga2O3 has significantly lower resistivity. The resistivity of Mg-doped and Fe-doped samples were relatively higher than the un-doped samples. Positron annihilation measurements were conducted to investigate the effect of compensating defects on conductivity.

1Funding by the Rickey Endowment

1Funds from a URC grant of Youngstown State University are gratefully acknowledged
B1.00012 Pulsed laser deposition of high quality rutile and anatase TiO$_2$ films. PRABIN DULAL, SAHIL AGARWAL, DAVE WINARSKI, FARIDA SELIM, Bowling Green State University — Titanium oxide (TiO$_2$) is one of the highly sought semiconducting oxide and due to its chemical and thermal stability and broad applicability, it has shown great potential for thin film applications in photo-catalysis, microelectronic devices, optical coatings, etc. In this work, we investigate the dependence of substrate type and growth parameters on TiO$_2$ phase formation for thin films synthesized by pulsed laser deposition method (PLD) under variable growth conditions and we show how to control TiO$_2$ structure in PLD process and obtain both pure Anatase and Rutile phases. Thin films of TiO$_2$ were fabricated by PLD on sapphire and silicon substrates and were characterized by X-ray diffraction (XRD), atomic force microscopy (AFM), optical absorption spectroscopy and Hall-effect measurements. XRD patterns revealed that a sapphire substrate is more suitable for formation of the rutile phase in TiO$_2$ while silicon substrate yields a pure anatase phase, even at a high temperature growth. AFM images show that the rutile TiO$_2$ films grown at 805°C on sapphire substrate have a smoother surface than anatase films grown at 620°C. Optical absorption spectra confirmed the band gap energy of 3.08 eV for rutile phase and 3.29 eV for anatase phase. All the deposited films exhibit the usual high resistivity of TiO$_2$.

B1.00013 A Computational Simulation of Belousov-Zhabotinsky Wave Behavior around Obstacles. NATHANIEL SMITH, NIKLAS MANZ, JOHN LINDNER, College of Wooster — We developed an Objective-C model to analyze the propagation behavior of reaction-diffusions waves around obstacles in a two-dimensional, narrow channel. By comparing the wave behavior with experimental results under known conditions, the program was verified to correctly simulate their propagation. Objects placed in the path of an initially planar propagating wave, impeded the wave’s movement due to the decreased speed of positively curved fronts after passing an object. We investigated the effect of various obstacle shapes (n-sided polygons, diamonds, ellipses) and extensions parallel (x-dimension) and perpendicular (y-dimension) to the channel and their influence on the total propagation time within the channel. We will also report on the effect of location of a defined number of obstacles within the channel, i.e., evenly spread or closer packing.

B1.00014 Transition to Chaos in an Unforced, Undamped Double Pendulum using Numerical Simulations. NOAH LENZ, CAVENDISH MCKAY, Marietta College — We study the transition to chaos in an unforced, undamped double pendulum using numerical simulations. Two properties, the Lyapunov exponent and the dimension of the invariant manifold, are used to determine the presence of chaotic behavior for a given set of initial conditions. Since the system is Hamiltonian, care must be taken in computing and interpreting the Lyapunov exponent. We find that the path from linear behavior to chaotic behavior depends on the initial distribution of energy in the system, and that for certain initial conditions spontaneous symmetry breaking and islands of nonchaotic behavior appear.

B1.00015 Improved sky subtraction for galaxy kinematics: application to Magellan spectroscopy of NGC 7727. NOAH PINKNEY, JASON PINKNEY, Ohio Northern University — The Earth’s atmosphere contributes light to galaxy spectra taken from the ground and this contamination can corrupt measurements of absorption line strengths and stellar velocity dispersions. We develop a method of scaling a non-contemporary sky exposure for use with galaxy spectra for which the galaxy light fills the entire slit. The method relies on the comparison of the spectral light profile (SLP) with a light profile taken from an independent, sky-subtracted image (ILP). The method is applied to longslit spectra of NGC 7727 (Arp 222) taken with the Magellan I (Baade) 6.5-m telescope. We demonstrate the improvement of stellar kinematical measurements with the new method. NGC 7727 is particularly interesting because it is undergoing a merger and our slit crosses the remnant of the secondary nucleus.

B1.00016 Stellar and gas kinematics in the elliptical galaxy NGC 2434. BRADLEY LOCKHART, JASON PINKNEY, Ohio Northern University — We observed the E0 elliptical galaxy NGC 2434 in 2001 using the B C spectrograph on the Magellan I 6.5-m telescope. The slit was not long enough to sample the sky spectrum without including galaxy light and so a new approach was developed for sky subtraction. We describe the approach elsewhere (see poster on NGC 7727) and report here on the findings for NGC 2434. The sky contamination in the NGC 2434 data was primarily airglow since it was observed in dark sky conditions. Our new sky subtraction method reveals that a little less than half of the counts at the ends of the slit (R=35") are attributable to sky and the rest are galaxy. The new method allows stellar kinematics measurements beyond 25" from the galaxy’s center at two different position angles. Our kinematics help clarify the galaxy’s major axis, which is ambiguous from surface photometry alone. Subtraction of a stellar template allows us to also measure extended gas kinematics in NGC 2434 from the residual [OIII] emission. We are aware of no other published gas kinematics for this galaxy.

B1.00017 Stellar and gas kinematics in the lenticular galaxy NGC 3489. MATTHEW SIBILA, JASON PINKNEY, Ohio Northern University — We observed the S0a lenticular galaxy NGC 3489 using the B & C spectrograph on the Magellan I, 6.5-m telescope in 2001. The slit was not long enough to sample the sky spectrum without including galaxy light and so a new approach was developed for sky subtraction. We describe the approach elsewhere (see poster on NGC 7727) and report here on the findings for NGC 3489. The sky contamination in the NGC 3489 data was primarily airglow since it was observed in dark sky conditions. Our new sky subtraction method reveals that about half of the counts at the ends of the slit (R=35") are attributable to sky and the rest are galaxy. The absolute galaxy counts are greater than the other two galaxies presented here, improving the reliability of kinematics beyond 25". We measure stellar velocity dispersions significantly lower than Caon et al (2000) but consistent with the results of SAURON (Emsellem et al. 2004). Subtraction of a stellar template allows us to also measure gas kinematics in NGC 3489 from the residual [0III] emission.

B1.00018 Electrostatics at the Molecular Level. ULRICH ZURCHER, Physics Dept., Cleveland State University — We use electrostatics and simple description of electronic repulsion to describe intra- and inter-molecular interactions of molecules. We describe hydrogen-bonding and relate the bonding energies to thermal properties, including the temperature of melting of ice.

B1.00019 Optical properties of SrTiO$_3$ and LaSrAlO$_4$. N.J. GANTZLER, S.V. DORDEVIC, The University of Akron — We report on the optical properties of SrTiO$_3$ and LaSrAlO$_4$, both of which are materials currently used as substrates for superconducting thin films. Their role in the superconductivity of these structures is not fully understood. In this work, we evaluate room temperature spectra collected from far-infrared to near-ultraviolet for both SrTiO$_3$ and LaSrAlO$_4$. Overall, the transmission and the reflection spectra of both materials are found to be less than 25% and above the bandgap the materials are completely opaque. The values for the band gaps, obtained from transmission spectra, are 3.21 eV for SrTiO$_3$ and 5.03 eV for LaSrAlO$_4$. The reflection spectra, also less than 25%, reveals signatures of interband transitions. After fitting the transmission and reflection spectra simultaneously using the Tauc-Lorentz model, we generate the optical conductivity along with other optical functions.
B1.00020 Molecular Organization of Vapor Deposited Rod-Like Molecules, ANDREW AUDLEY, JUTTA LUETTMER-STRATHMANN, Department of Physics, The University of Akron — Thiophenes are π-conjugated organic molecules with applications in electronic devices. Alpha-sexithiophene (α-6T) is a rod-like molecule consisting of six thiophene rings. Previous experimental research has shown that vapor deposition of rod-like organic molecules onto substrates of varying temperatures yields varying material phases. These include smectic liquid crystalline phases, which have been shown to promote anisotropic charge carrier mobility. In this work, we use a course-grained model for α-6T, representing it as a chain of discotic particles with fixed bond lengths and fixed bond angles. We perform Monte Carlo simulations of multiple chains introduced at varying rates in vacuum near two adsorbing surfaces. These simulations are not chemically realistic, instead focusing on the general features of the physical systems. The goal of this work is to simulate vapor deposition of materials on a substrate under varying temperatures and deposition rates and investigate the resulting phases.

B1.00021 Two-Stream Instability in Graphene, MITCHELL DUFFER, BEN YU-KUANG HU, The University of Akron — We investigate the unstable modes of the two-stream instability in graphene. This instability occurs when a population of electrons streams past another inside graphene. We obtain unstable modes by numerically determining the zeros of the non-equilibrium graphene dielectric function using MATLAB. The dielectric function used in this study, in contrast to previous studies, includes the effects of the particle-hole excitation continuum (PHEC) that normally quells the evolution of unstable plasmons. MATLAB’s built in zero solver is employed to solve the sixth order polynomial and determine its roots. For some range of parameters, the zeros are found to exist in upper half of the complex plane. This indicates that there is a range of unstable modes that exists even with the incorporation of PHEC. The presence of these unstable modes signifies that the plasmons’ amplitudes increase with time.

B1.00022 Evidence for Time-Reversal Symmetry breaking in 4f-doped Bismuth Selenide, STEPHEN HOFER, DIPANJAN MAZUMDAR, Southern Illinois University - Carbondale — Time-Reversal Symmetry (TRS) is a hallmark of Topological Insulator (TI) systems. TRS in conjunction with the strong Spin-Orbit Coupling (SOC) present in Bismuth Selenide is responsible for the unique robust surface states shown in this material. Breaking TRS in these systems in order to achieve strong spin polarization requires the presence of a magnetic field throughout the material. We achieve this effect by doping the system with 4f elements whereby the magnetic field is provided by the local magnetic moments of the dopants manifesting ferromagnetic behavior. In this work we show high quality crystal growth using X-Ray Diffraction, ferromagnetic behavior in our doped system using SQUID, and Electronic Bandstructure using Resonant ARPES.

B1.00023 Measuring adsorbate-induced resistivity changes on Au (111) thin films1. JIANG HONG WAN, DENNIS KUHL, Marietta College — Theoretical predictions for the relationship between broad-band adsorbate-induced changes in the resistivity and the reflectance of thin metal films have been shown in the literature to fail qualitatively in all experimental tests, and to fail qualitatively in some experimental tests. We are building an experiment that will enable both resistivity change and reflectance change to be measured simultaneously on the same sample, which should enable clarification of some issues of disagreement between experiment and theory. The experiment requires ultra-high vacuum, four-probe resistance measurements, a lock-in amplifier technique, and gas dosing methods. Preliminary measurements of resistivity change for dibutyyl sulfide adsorption on a 150 nm thick, polycrystalline gold (111) film will be presented.  

1 funding by the Rickey Endowment

B1.00024 Building a three-dimensional model of kinesin stepping on a microtubule, MATTHEW MURROW, JUTTA LUETTMER-STRATHMANN, Department of Physics, The University of Akron, Akron, OH 44325-4001 — The motor protein kinesin plays an integral role in cell function, transporting, for example, vesicles and proteins. Kinesins are composed of two heads, two neck links, and a coil connecting these parts to the carried cargo. Kinesin molecules, upon ATP binding, have been shown experimentally to walk along tubulin-based protein structures called microtubules in a hand-over-hand stepping motion, carrying their cargo eight nanometers per step. A number of kinesin models for computer simulations have been developed but none are able to replicate the observed stepping efficiency. Atomic models provide insight into details of the moving motor protein but are computationally too expensive to simulate stepping. Abstract models are more efficient but can be difficult to relate to the biological system. The goal of this work is to build a coarse-grained 3D protein model of the kinesin-microtubule complex that can be simulated economically and replicate the stepping efficiency of the motor protein. To this end we are building an interaction site model for the protein heads and neck-linker domain that will be combined with an existing microtubule model for Brownian motion simulations.

B1.00025 Rotating Dust Rings in a Complex Plasma, WILLIAM THEISEN, Ohio Northern University — A ring shaped plasma potential was generated inside a complex plasma using a carved out ring shaped metal anode. A simple dust ring formed inside the circular potential trough. Occasionally the ring would start to rotate due to the unbalanced forces generated by the flow of charges in the plasma. Particle position data was taken and analyzed using standard techniques. Results were compared with predictions of normal mode calculations.

B1.00026 Super Soft Particle Which Arises from Dimension of Information, HASSAN GHOLIBEIGIAN, Retired, KAZEM GHOLIBEIGIAN, Student — It seems that there is dimension of information which is nested with space-time. Density of information [Super Soft (i.e. zero energy) Particles] (SSP) is proportionate with corresponding density of matter and energy in space-time. Because of particles in matter and energy need information to know their next quantum state. Therefore, the SSP which arise from dimension of information should be much matched with fundamental particles. Because particles in their motion can’t delay for receiving and analyzing SSP for finding their next quantum state. Therefore, photons and gravitons are which inside the black hole can’t delay for receiving soft hair (soft photons and gravitons) from horizon for analyzing and understanding their next quantum state. Therefore, this is a lack in Hawking and their co-workers’ paper under title of “Soft Hair on Black Holes”. Soft particles (sub-particles) are as a door to the dimension of information should be much near/matched with fundamental particles. Because particles in their motion can’t delay for receiving and analyzing SSP for finding their next quantum state. Soft photons and gravitons are which inside the black hole can’t delay for receiving soft hair (soft photons and gravitons) from horizon for analyzing and understanding their next quantum state. Therefore, soft quarks involving quark, get the SSP (information for quarks), for analyzing and understanding quark’s next quantum state. Also the soft gluons receive SSP (information for gluons) for finding their pathway for interaction with quarks.

B1.00027 BLiSS Physics: A Studio Physics Course for Life Science Students, VASHTI SAWTELLE, KATHLEEN HINKO, Michigan State Univ — Introductory Physics for the Life Sciences (IPLS) courses are gaining momentum in the physics education community, with the creation of multiple curricula for a variety of implementation strategies. At Michigan State University, we have designed an integrated lab-lecture (studio style) introductory physics course that meets the needs of life science students. Our design of this course focused on (1) connecting the disciplines of physics, biology, and chemistry through designing authentic tasks for students in collaboration with biophysicists, (2) incorporating computational simulations that model complex biological phenomenon, and (3) building positive relationships for life science students with physics. This poster will describe our overarching approach to the design of this course, share example curricular materials for manifesting these design goals in the classroom and describe some of the ongoing research on this course.
B1.00028 What counts in laboratories: Developing a practice-based identity survey
KELEY FUNKHOUSE, MARCOS CABALLERO, PAUL IRVING, VASHI SAWTELLE, Michigan State University — An essential step in the process of developing a physics identity is the opportunity to engage in authentic physics practices. Physics laboratory courses are generally structured as a place for students to gain experience with physics practices. This makes laboratory courses an ideal place to look at the impact these authentic science practices have on students physics identity. As part of the development of a practice based identity survey, we have interviewed students in a variety of physics lab classes, from intro algebra based to advanced lab, to gain insight into their interpretations of different commonly discussed practices. To ground our survey in students experiences, we have asked questions about what these practices mean to the students. We present our findings on how students interpret these practices and situate themselves with respect to the practices as an indicator of their physics identity.

B1.00029 Teaching at African Institutes for Mathematical Sciences
PAWEL DANIELEWICZ, Michigan State Univ — African Institutes for Mathematical Sciences (AIMS) runs one-year residential Masters Programs at 6 Institutes across Africa under their Next Einstein Initiative (NEI). The goal of AIMS NEI is to bring the best students getting bachelors degrees at African universities to the level where they can succeed in the graduate programs at universities outside of Africa. Danielewicz taught at the AIMS Institutes in Tanzania and Rwanda. He discusses day-to-day operation of AIMS NEI, their funding, recruiting of students, lecturers and tutors and his personal experiences in teaching at the Institutes.

B1.00030 Life After VPYthon: Developing E&M Computer Labs Using Matplotlib & Bokeh
THOMAS FINZELL, Univ of Michigan - Ann Arbor, DIALUP TEAM — The Developers of Instructions, Assessments, and Lessons for Undergraduate Physics (DIALUP) team at the University of Michigan has developed a suite of three novel computational labs for second semester introductory physics. Escewing the oft used VPYthon package, we have instead incorporated components from popular Python visualization packages that students could potentially utilize in their future work; specifically, Matplotlib and Bokeh. Using these modern packages allows us to incorporate many new tools, including Widgets, which can give students a new layer of information feedback. All of this lab material will be made available through the Partnership for Integration of Computation into Undergraduate Physics (PICUP) webpage. The DIALUP team is composed of: Chelsea Hendrus, Grace Kerber, Gile Leung, Jordan Roth, and Alec Tewsley-Booth.

B1.00031 Using machine learning to predict integrating computation into physics courses
NICHOLAS YOUNG, MARCOS CABALLERO, Michigan State University — We recently completed a national survey of faculty in physics departments to understand the state of computational instruction and the factors that underlie that instruction. We then used supervised learning to explore the factors that are most predictive of whether a faculty member decides to include computation in their physics courses. We find that personal, attitudinal, and departmental factors vary in usefulness for predicting whether faculty include computation in their courses. We will present the least and most predictive personal, attitudinal, and departmental factors.

B1.00032 Exploring Performance Differences in Science, Technology, Engineering, and Math Courses
NITA KEDHARNATH, University of Michigan — Performance differences in science, technology, engineering, and mathematics (STEM) courses are an unfortunate reality at many large universities throughout the country. Despite entering STEM classes with the same cumulative GPA, major, ACT math scores, and other relevant academic factors, often times women and minorities underperform. After examining different aspects of the classes, we conclude that stereotype threat, where a person experiences a fear of confirming a negative stereotype about their identity when in an evaluative environment, is a likely cause for these performance differences since the extra anxiety often leads to underperformance.

Friday, March 23, 2018 8:00PM - 8:45PM
Session C1 Invited: Plenary II Biomedical and Physical Sciences Building 1415
8:00PM C1.00001 Diversity & Inclusion: Counting things that count Not everything that counts are to be counted, and not everything that can be counted counts. SUSAN WHITE, American Institute of Physics — We know that there are underrepresented groups in physics and astronomy. In this talk we will look at the representation of underrepresented groups from the students taking high school physics through the students earning PhDs in physics and astronomy. Women are underrepresented. African Americans are underrepresented. Hispanics are underrepresented. Native Americans are underrepresented. We will review the numbers. Then we will look beyond representation at additional factors that count.

Saturday, March 24, 2018 9:00AM - 9:45AM
Session D1 Invited: Plenary III Biomedical and Physical Sciences Building 1415
9:00AM D1.00001 Fostering Physics Learning and Interest for Middle School Girls and Boys through STEM Integration
EMILY A. DARE, Michigan Technology University — It is well-known that women are highly underrepresented in the field of physics, typically comprising only around 25% of physics bachelor’s degrees. Although many factors impact one’s career decisions, one factor that is thought to play a significant role related to STEM careers is K-12 educational experiences. By exploring what those educational experiences are and how they impact students’ interest and attitudes towards careers in physics and other STEM fields, educational researchers can shed light on understanding why few women choose to pursue STEM careers. Reforms in K-12 science education that push for a more integrated approach to science through the incorporation of other STEM fields in meaningful contexts provide an ideal opportunity to explore how such changes impact student interest. This is increasingly important for underrepresented populations in STEM, such as women. This presentation will focus on the perceptions of 6th grade students regarding physics and physics-related careers. This work explores similarities and differences of girls’ and boys’ perceptions of physics and physics-related careers through surveys and focus group interviews as they are immersed in a classroom that combines girl-friendly instructional strategies (Hussler et al., 1998; Newbill & Cennamo) with an integrated STEM framework (Moore et al., 2014). Understanding these perceptions may lead to identifying what type of classroom culture fosters students’ interest and self-concept in physics, and may further reveal pathways to interest more young women in pursuing physics-related careers.
10:15AM E1.00001 Beyond the statistics cookbook: The geometric approach to the analysis of experimental data. STEVEN MARX, Sherwin-Williams Co, Breen Tech Ctr — The numerical results from a set of experimental measurements may be expressed as a single point in n-dimensional Euclidean space. Finite-dimensional vector space methods can then be used to fit a statistical model to such a data set, as well as to assess the significance of the terms in the model. The outcome of the vector space analysis is precisely the same as the result obtained with the usual analysis using the interminable nested sum notation found in all statistics texts. However, working in this way, concepts such as degrees of freedom, mean squares, and correlation coefficients acquire a clear and simple geometric interpretation. The necessity for verification of model assumptions when presenting data analyses will be briefly discussed.

10:27AM E1.00002 The Art of Collaboration. TAOUIF NADJII, Interlochen Arts Academy — The presenter will share instances of collaboration with various arts instructors to assist them and their students in making sense of the physics behind their respective crafts. In addition, the presenter hopes that this would encourage more physics colleagues to extend a helping hand that would foster ties of fruitful collaborations between them and their counterparts in the arts areas. Physics is too valuable to not be shared with fellow artists be they seasoned practitioners or passionate students who love the arts and pursue them.

10:39AM E1.00003 Simulating Physics with Moho Pro. LARRY KOLOPAJLO, Eastern Michigan University — Gravity, the Inclined plane with friction, a pendulum, gears and particles can be simulated with the easy to use Physics Engine built into Moho Pro. Some animations will be shown.

10:51AM E1.00004 The Fermi Paradox. MICHAEL C. LOPRESTO, University of Michigan — When pondering the question of whether or not life exists elsewhere in the galaxy, Enrico Fermi asked, “If they are out there, why aren’t they here?” Student answers to that question towards the end of a one-credit semester-long course on “Aliens” will be discussed.

11:03AM E1.00005 Formative Assessment and Gameful Learning in a High School Classroom. ROBERT TARCHINSKI, University of Michigan — As secondary schools continue to adopt bring your own device (BYOD) or one-to-one technology policies, portable computing devices have become ubiquitous in schools. Such devices open new avenues for teachers to assess student learning and engage students with challenging content. I will discuss two applications currently being used in the Physics classroom at Chelsea High School. The first is Go Formative which is used to assess student progress during class. The second is the Mind app which serves students with questions to help promote understanding of Physics concepts. Students complete learning missions and earn medals representative of their mastery of the content. These questions help reinforce concepts discussed in class, challenge deeply rooted misconceptions and engage students in learning Physics. In this talk I will describe these two applications and present ideas for other applications of mobile technology.

11:15AM E1.00006 An inexpensive capacitive force sensor laboratory for introductory physics labs. CHRIS NAKAMURA, RYAN A. FRENCH, JOHN J. POTTS, MATTHEW D. VANNETTE, Saginaw Valley State University Physics Department — We present a laboratory activity in which students build and characterize a capacitive force sensor. The activity uses a simple foil capacitor and LCR meter. We have tried the activity with algebra-based physics students but it is appropriate for other levels. The lab uses ideas of approximation either qualitatively for high school or algebra-based physics, or via Taylor expansion for calculus-based physics. For advanced undergraduate students we are exploring using the sensor in an LC oscillator. The experiment highlights application of physics in an interesting context.


10:15AM E2.00001 Mechanism of Auxetic Structures Designed and Fabricated with 3D Printer1. MARTHA MATA, XIN DU2, Aquinas College — Metamaterials are bulk objects with special mechanism properties defined by their repetitive inner structures, rather than the materials they are made of. One of the special mechanisms is “auxetic behavior”; when the materials are stretched in one direction, unlike conventional materials, they will also expand in the lateral direction. In this project we studied the dependence of Poisson’s Ratio on the geometric parameters of auxetic structures. We used 3-D printer to efficiently design and produce honeycomb auxetic structures. With an innovative experimental setup and image analysis techniques, we are able to study the pulling force and the corresponding lateral expansion of auxetic structures with various geometric parameters. Also, we found a linear relationship between the Poisson’s Ratio and the geometric parameter of the honeycomb auxetic structure. Our result is consistent with theoretical analysis.

1Mohler-Thompson Scholarship
2PhD.

10:27AM E2.00002 Intriguing photoconductivity in bulk oxides at room temperature. POONEH SAADATKIA, PETR STEPANOV, FARIDA SELIM, Department of Physics and Astronomy, Bowling Green State University — Complex oxides with the ABO3 perovskite crystal structure reveal a range of spectacular phenomena such as superconductivity, ferroelectricity, and metal-insulator transitions. SrTiO3 (STO) has been the focus of intense research in the world of oxide materials due to its functional, dielectric and ferroelectric properties. In this work, Hall and photo-Hall measurements have been carried out on a number of as-grown STO samples provided from different suppliers to investigate the photo-response of bulk STO single crystals and its dependence on photon energy and intensity. Most of samples were photoconductive at room temperature but no persistent photoconductivity was observed. Vacancies are known to be dominant defects in perovskite oxides and significantly affect the material properties. Therefore, identifying the nature of vacancy defects is crucial to understand the origin of these novel photoconductivity phenomena in complex oxides in STO bulk single crystals. Positron annihilation lifetime spectroscopy and digital coincidence Doppler broadening spectroscopy were applied to examine the presence of defects. The measurements revealed the strong dependence of photoconductivity on defect concentration under illumination of sub band gap visible light.
10:39AM E2.00003 Using Match Stick Arrays to Analyze Forest Fire Propagation Along a Slope

ABIGAIL AMBROSE, NIKLAS MANZ, College of Wooster — The effect of a forest floor slope $\theta$ on the propagation speed $v$ of forest fires was experimentally analyzed using physical, 3D-printed models with match stick arrays to represent the trees. Various models for three specific distance conditions between neighboring match heads were created. In each model type the distance between the match heads $\Delta d$ is kept constant along the horizontal ($x$-model), along the vertical ($z$-model), and along the slope ($r$-model). For all three models, the slope-speed relationship $v(\theta)$ along the incline for both, the upward and downward propagation of the fire fronts was determined by measuring the time the front needed to propagate through the length of the model. Each model was best fit with a different mathematical function: the $z$-model with an exponential curve, the $r$-model with a quadratic curve, and the $r$-model with a straight line.

1 NSF-DMR 1566003 and The College of Wooster

10:51AM E2.00004 ZnO Films Printed by Inkjet and Aerosol Jet Techniques for Flexible Electronics

DAVID WINARSKI, Bowling Green State Univ, ERIC KREIT, EMILY HECKMAN, Air Force Research Laboratory Sensors Directorate, ERIK FLESSBURG, MICAH HASÉMAN, Bowling Green State Univ, ROBERTO AGA, Air Force Research Laboratory Sensors Directorate, FARIDA SELIM, Bowling Green State Univ — Zinc oxide (ZnO) thin films have remarkable versatility in flexible electronics applications. Here, we report simple ink synthesis and printing methods to deposit ZnO photodetectors on a variety of flexible and transparent substrates, including polyimide (Kapton), polyethylene terephthalate, cyclic olefin copolymer (TOPAS), and quartz. X-ray diffraction analysis revealed the dependence of the film orientation on the substrate type and sintering method, and ultraviolet–visible (UV–Vis) absorption measurements revealed a band edge near 380 nm. Van der Pauw technique was used to measure the resistivity of undoped ZnO and indium/gallium-codoped ZnO (IGZO) films. IGZO films showed lower resistivity and larger average grain size compared with undoped ZnO films due to addition of In$^{3+}$ and Ga$^{3+}$, which act as donors. A 365-nm light-emitting diode was used to photoirradiate the films to study their photoconductive response as a function of light intensity at 300 K. The results revealed that ZnO films printed by aerosol jet and inkjet techniques exhibited five orders of magnitude photoconductivity. These findings indicate that ZnO films are viable options for flexible electronics like photodetectors, and field-effect transistors.

1 Dayton Area Graduate Studies Institute

11:03AM E2.00005 Fabrication of One Dimensional Photonic Crystal By Sputtering and Sol Gel Methods

NICHOLAS BORUCKI, TOM ODER, Youngstown State University — TiO$_2$ and SiO$_2$ are two oxides that offer one of the largest refractive index differences, which could be tailored for various optical device applications. A one dimensional photonic crystal (1-D PC) within the UV-visible spectrum made of thin multilayer films of TiO$_2$ and SiO$_2$ was fabricated. Two methods of deposition were compared: magnetron sputtering and sol-gel spin coating. The photonic band gap (PBG) was theoretically and experimentally determined by controlling the periodic spacing of the constituent materials. PBG’s were observed between 200 - 350 nm in both samples. Furthermore, steps towards making a PC with 2-D and omnidirectional band gaps were investigated. Further details of the fabrication steps as well as the specific results obtained will be presented.

1 Support of funds from a URC grant of Youngstown State University is gratefully acknowledged

11:15AM E2.00006 Optical Properties of Sputter-Deposited Gallium Oxide Thin Films

SUNDAR BABU ISUKAPATI, TOM ODER, Youngstown State University — We report on studies conducted on gallium oxide (Ga$_2$O$_3$) thin films grown on c-plane sapphire substrates by RF magnetron sputtering from a 99.9% pure ceramic target. Single and poly crystalline thin films were obtained by varying the composition of Ar and O$_2$ gas used in the deposition; substrate temperature and post deposition annealing treatment. The optical characteristics were obtained by UV–VIS spectroscopy measurements which yielded transmission of 90 - 95%, optical bandgaps of 4.7 - 4.8 eV. Structural characteristics were analyzed through x-ray diffraction measurements. A single diffraction peak at 2$\theta$ = 37°, assigned to the (4 0 1) plane was obtained for a film annealed at 1000°C for 1hour in N$_2$ atmosphere. An attempt to dope the films using Sn for n-type conductivity was made. Optical bandgaps of 6%, 9% and 10% Sn-doped Gallium oxide films were 4.72, 4.57 and 4.56 eV, respectively.

1 Funding support from a URC grant of Youngstown State University is gratefully acknowledged

Saturday, March 24, 2018 10:15AM - 11:27AM – Session E3 Contributed: Condensed Soft Matter, and Chemical Physics Biomedical and Physical Sciences Building 1300 -

10:15AM E3.00001 Measurements of Ultrasound Backscatter Coefficient

TIMOTHY STILES, Kettering University — Quantitative ultrasound imaging can produce images based on underlying physical properties of tissue. Of the various parameters that are available for imaging, the backscatter coefficient (BSC) has been of particular interest as it relates to tissue microstructure and may indicate the presence or progression of various conditions. Despite being a basic physical parameter of tissue, measurements of BSC remain difficult in practice. Interlaboratory comparisons have yielded results that vary by up to two orders of magnitude for identical samples of tissue-mimicking materials. This investigation seeks to characterize two possible reasons for such discrepancies: nonlinear propagation and errors arising from data reduction. BSC was measured for a tissue-mimicking material consisting of glass microspheres embedded in agar gel. Data were collected over a range of peak acoustic pressures and using a variety of data reduction and analysis schemes. Results indicate that data reduction methods yield comparable results and that BSC can depend dramatically on input pressure, with difference of an order of magnitude for results collected at pressures ranging from 0.15 to 1.5 MPa in water.

Funding support from a URC grant of Youngstown State University is gratefully acknowledged
10:27AM E3.00002 Single CaO accelerated densification and microstructure control of highly transparent YAG ceramic1. TIANYUAN ZHOU, SAHIL AGARWAL, POONEH SAADATKIA, FARIDA SELIM, Bowling Green State University, Bowling Green Ohio, USA, LE ZHANG, HAO CHEN, Jiangsu Normal University, Xuzhou, Jiangsu, China, BOWLING GREEN STATE UNIVERSITY COLLABORATION, JIANGSU NORMAL UNIVERSITY COLLABORATION — In this work, CaO single dopant was adopted to realize the densification and microstructure control of fine-grained YAG ceramic by a solid state reaction method and highly transparent YAG ceramics were obtained after vacuum sintering at 1820 °C. The average grain size was only 2.7 µm, when the amount of CaO used was 0.045 wt.%. It was found that the CaO dopant promoted densification of YAG ceramics when the sintering temperature was lower than 1660 °C, however it dramatically inhibited grain growth when the sintering temperature was further increased.  

1The authors acknowledge the generous financial support from Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD)

10:39AM E3.00003 Temperature dependent luminescence characteristics of Ce: YAG nanoporphors and transparent ceramics and observation of novel phenomenon. SAHIL AGARWAL, Bowling Green State University — Cerium-doped YAG (Ce: YAG) has received considerable attention because of its intense emission at 525 nm and its important role in converting blue emission to white light in InGaN light-emitting diodes. In this work, the physical and luminescence properties of Ce: YAG NPs and their dependence on annealing temperature and atmosphere were investigated. Furthermore, photo-luminescence (PL) was measured as a function of temperature and compared with PL from Ce: YAG single crystals and transparent ceramics to understand the mechanism of luminescence decay with temperature. While the characteristics of PL emission as a function of temperature for single crystals and NPs are similar and follow common decay trends, Ce: YAG transparent ceramics exhibit an interesting unusual increase in PL with temperature. We explained this unique novel behavior by a 4-step mechanism involving localized states in the band gap, and provided evidence from thermo-luminescence measurements to support this interpretation. The work reveals a new luminescence phenomenon arising from the overlap of PL and TL emissions; this phenomenon is most likely characteristic of transparent ceramics.

10:51AM E3.00004 Correlation between native defects, conductivity and green luminescence in ZnO single crystals, NARESH ADHIKARI, PETR STEPA诺OV, POONEH SAADATKIA, MICAH HASEMAN, JACK T. WARFIELD, Bowling Green State Univ, GERALD E. JELLISON, LYNN A. BOATNER, Oak Ridge National Laboratory, FARIDA SELIM, Bowling Green State Univ, SELIM LAB, BOWLING GREEN STATE UNIVERSITY TEAM, CENTER FOR RADIATION DETECTION MATERIALS AND SYSTEMS, OAK RIDGE NATIONAL LABORATORY TEAM — Zinc oxide (ZnO) attracts great attention in the optoelectronics due to its direct wide bandgap and high exciton binding energy. Native point defects play a significant role on the electrical and optical properties of ZnO and should be well investigated to control the electronic properties of ZnO. In this work, bulk ZnO single crystals grown by different methods were studied using a wide range of characterization techniques including Hall Effect, Thermo-luminescence (TL) spectroscopy, Photoluminescence spectroscopy (PL), Positron Annihilation Lifetime Spectroscopy (PALS) and digital coincidence Doppler broadening positron annihilation spectroscopy. It was found that the increase in well-known green luminescence is associated with the decrease in conductivity and charge carrier concentration. Positron lifetime spectroscopy measurements were carried out to reveal the origin of defects responsible for decreasing the conductivity and enhancing the green luminescence. Thermo-luminescence measurements reveal that the presence of hydrogen donors in the conductive samples. Lastly, it was interesting to observe the decrease in the ratio between green luminescence and near band emission with increasing laser power.

11:03AM E3.00005 Vertical Organic Tunnel Field-Effect Transistor1, SHIYI LIU, Kent State University, MAX L. TIETZE, King Abdullah University of Science and Technology, AKRAM AL-SHADEEDI, University of Baghdad, VIKAH KAPHE, Kent State University, CHANGMIN KEUM, University of St Andrews, BJORN LUSSEM, Kent State University — Among the large number of different OFET designs, vertical OFETs stand out for their aggressively shortened channel length and the potential to be integrated vertically with devices such as organic OLEDs or photodiodes. However, it is challenging to control the leakage current between the drain and source by the gate electric field [Greensman, M. et al. Journal of Applied Physics 120, 204503]. Here, to further optimize vertical OFET, we propose a novel OFET concept— vertical organic tunnel field-effect transistors (VOTFETs). To realize VOTFET, drain and source contacts are heterogeneously doped in a Pentacene-based vertical OFET, which forms a p-i-n structure. Depending on the mechanism of charge carrier injection, the transistor can work in two distinct modes — forward and backward (tunneling). The injection of charge carriers is systematically investigated, which shows that charge carriers are injected by Zener tunneling in the tunneling mode. A comparison to the lateral OFET shows that it has an improved performance. Overall, this study opens new ways to optimize the performance of organic transistor. Furthermore, the device principles discussed here can be applied to other material systems, broadening the impact of the results.

1National Science Foundation (EECS 1709479)

11:15AM E3.00006 High Transconductance Organic Electrochemical Transistor With Ionic Gel Electrolyte And Its Possible Application As Biosensor, VIKAH KAPHE, SHIVA BHATTRAI, SHIYI LIU, BJORN LUSSEM, Kent State University — Organic Electrochemical Transistors (OECTs) are seen as a key device for the field of bioelectronics. OECTs operate in aqueous environment and at low voltages, they can be flexible, and they are bio-compatible. Currently, OECTs are mainly used as sensors, e.g. to detect ions, metabolites, hormones, DNA, Dopamine, lactic acid. Furthermore, they are used to record brain activity, the activity of electrically active cells or tissues, or to drive an active matrix display[1][2]. Transconductance is the most important parameter of OECTs as it determines the performance of the device. Here we discuss high transconductance OECTs and their limiting factors[3]. We present OECTs with a transconductance greater than 2 mS and on/off ratios in excess of 107 using a room temperature ionic liquid (C2MIM EtSo4) and PBS as electrolyte. This electrolyte can be crosslinked into a solid gel, which is essential to integrate these devices into wearable sensors. We also discuss the origin of gate bias stress and hysteresis effects of this transistor, and propose approaches to minimize these instabilities. Furthermore, possible application of OECTs as a lactate acid sensor and neurotransmitter sensors are evaluated. References [1] X. Strakosas, M. Bongo, 2015, 41735, 1. [2] D. Khodagholy, J. Rivnay, M. Sasselli et. al., Nat. Commun. 2013, 4, 2133. [3] V. Kaphle, S. Liu, A. Al-Shadeedi, C. M. Keum, B. L??ssem, Adv. Mater. 2016, 28, 8766.

Saturday, March 24, 2018 1:00PM - 1:45PM – Session F1 Invited: Plenary IV Biomedical and Physical Sciences Building 1415 -
1:00PM G1.00001 Gender in physics education: Looking back and looking forward

ADRIENNE TRAXLER, Wright State University — A decades-long body of physics education research (PER) has sought gender differences in students participation, performance, or attitudes toward physics. Though valuable, this work tends to rely on quantitative comparisons between binary and opposed groups. This framework is well suited for drawing attention to inequities in access or classroom support. However, such a “first order” approach misses many details of students’ experiences and identities, and presupposes unbiased instruments to measure learning—a claim that is often untested. To address the pervasive challenges of sexism in our classrooms, whether entering from wider society or in physics-specific manifestations, we must broaden our understanding of gender. I will discuss some past trends and under-studied areas of gender-focused PER, and supplement with work from science education, gender studies, or more recent PER that breaks the mold of earlier studies. These alternate approaches showcase the power of qualitative methods, question the binary deficit-based model of gender, and explore complexities of identity such as the intersection of race and gender. I will conclude by suggesting new physics investigations that might grow from an expanded gender framework.

Saturday, March 24, 2018 2:00PM - 3:12PM –
Session G1 Contributed: Physics Education OSAPS/MIAAFT Joint Session II Biomedical and Physical Sciences Building 1400 -

2:00PM G1.00001 Expanding conceptions of relevance with a systems view

ABHILASH NAIR, VASHTI SAWTELLE, Michigan State University — National policy recommendations and major requirements position physics reasoning and content knowledge as being essential and relevant to students earning a degree in STEM or a career in the health sciences. Meanwhile, research has documented that students typically demonstrate an unfavorable shift in attitudes toward physics and leave the physics classroom stating that physics is less connected to the world than when they started the course. Students unfavorable responses to items on these measures are often interpreted as students not perceiving the relevance of physics to the different facets of their lives: the real world, their everyday life, their personal interests, or their future careers. We discuss how current approaches to measure students’ attitudes and beliefs around relevance are limited in the contexts that they probe. Utilizing case studies of students in an introductory physics for the life-sciences course, we present how a systems-view of students connections to physics develops a richer account of the ways in which students may find physics relevant.

2:12PM G1.00002 Investigating the characteristics of teams working to improve STEM instruction

DIANA SACHMPAZIDI, ALICE OLMSSTEAD, CHARLES HENDERSON, ANDREA BEACH, Western Michigan University — “Effective instructional change often requires teams. But, what makes a team successful? Using grounded theory, we have analyzed interviews with team-based project leaders from thirty departments across the U.S. In this talk, we will describe the initial results of that analysis, which focuses on factors that could influence team processes and team dynamics. We will also describe the planned next steps of our research: to collect empirical data from team members and modify our framework accordingly. Our ultimate goal is to create recommendations for what teams can do to increase their chances of success.

2:24PM G1.00003 Progression of student feedback and computational skills in P-Cubed

PAUL HAMERSKI, DARYL MCPADDEN, PAUL IRVING, MARCOS D. CABALLERO, Michigan State University — Projects and Practices in Physics is a sequence of two introductory, calculus-based physics courses, covering mechanics (P-Cubed) and electricity and magnetism (EMP-Cubed). Both P-Cubed and EMP-Cubed are flipped classrooms, where students read online notes and complete homework assignments at home and spend class time working on complex problems (or projects) in small groups. The projects are designed to be intricate and challenging, often asking students to model the situation using minimally-working VPython code. This requires students to work together to create a plan, make simplifying assumptions, and make choices as work through their solution. In addition to incorporating basic computational modeling, a key feature of P-Cubed and EMP-Cubed are that students get individualized feedback from an instructor on how well they understood the material and how they functioned in the group. We present the progression of the student feedback and development of computational skills through the P-Cubed and EMP-Cubed curricula.

2:36PM G1.00004 Reimagining Education at Scale: the University of Michigan’s Foundational Course Initiative

TIMOTHY MCKAY, University of Michigan — The University of Michigan educates at scale, introducing thousands of students every year to topics as various as Linguistics, Physics, and Screen Arts. Large foundational courses play an outsized role in this process. This year, we are launching a 5millioncampus wide Foundational Course Initiative to establish a 21st century collaborative approach to the creation and instruction of these courses. Faculty, staff, and students participate, leveraging the resources of the Center for Research on Learning and Teaching.

2:48PM G1.00005 Instructor approaches to teaching computational physics problems in problem-based courses

ALANNA PAWLAK, PAUL W. IRVING, MARCOS D. CABALLERO, Michigan State University — Increasingly, introductory physics courses are focusing on the practices, for example, by including computational problems that allow students to engage with programming practices and numerical problem-solving methods used by physicists. Understanding how instructors teach such problems is important for improving instruction. We interviewed instructors in a problem-based mechanics course that incorporates computational problems. These instructors were undergraduates who were previously successful students in the course. Their prior involvement as students, along with their fewer experiences with programming and physics compared to faculty instructors, give them a unique perspective on teaching in the course. We present here thematic analysis of these interviews.

3:00PM G1.00006 Student pathways through the physics major

JOHN AIKEN, University of Oslo, Centre for Computing in Science Education, Department of Physics, MARCOS D. CABALLERO, Michigan State University — As students go through their undergraduate careers, they take courses, interact with other students, and sometimes change their majors. Understanding what factors may act as precursors to major change can help advising faculty understand their students. This work uses data from the Michigan State registrar to examine factors when students in physics change their major. Our data includes time stamped courses taken, grades, and student demographics. This data set has been used previously to describe the pathways students take into and out of the physics major.

Saturday, March 24, 2018 2:00PM - 3:12PM –
Session G2 Contributed: Applied Physics and Materials Science II Biomedical and Physical Sciences Building 1420 -
2:00PM G2.00001 Percolation Through Voids Around Structurally Disordered Sand Grains, NICHOLAS MCGUIGAN, DONALD PRIOUR, Youngstown State Univ — Fluid flow or charge transport through porous materials takes place within voids around impermeable grains. With increasing density of grains, fluid flow diminishes, ultimately ceasing at the percolation transition separating configurations macroscopically navigable; and those which block fluid flow in the bulk limit. Theoretical studies of void networks have generally been confined to monodisperse systems of identical particles, with no calculations of percolation thresholds for geometrically diverse grains. In addition to positional and orientational disorder, we incorporate structural disorder by imposing random valance reconstructions akin to stochastic porous media. We consider conductive pathways embedded into non-conductive voids with random proportions. More comprehensibly, we also examine configurations of structurally disordered tetrahedra and parallelepips with both random perturbations in edge lengths and dihedral angles. Reflecting the fact that grains in practice are irregular polyhedral with various numbers of faces, we also implement structural disorder by using Voronoi tessellation to carve out irregularly shaped grains. Intuitively, this approach mimics the formation of grains in nature from fractured larger objects.

2:12PM G2.00002 Modified Propagation of Belousov-Zhabotinsky Waves in a Quasi-1D System1, JACK MERSHON, CHASE FULLER, NIKLAS MANZ, College of Wooster — The Belousov-Zhabotinsky (BZ) reaction was used to investigate the effect of fluid flow on the behavior of reaction-diffusion waves. Solutions were filled into glass capillary with inner diameter of 0.45 mm to create a quasi-1D system. The solutions were then advected by fluid flow. Normal reaction-diffusion waves were subjected to flow in opposition to the wave’s propagation at a rate equal to the wave’s speed without flow. The advection resulted in the initial fronts propagating at a significantly reduced speed than normal, though some forward propagation was still observed suggesting that the flow was not sufficient to stop forward wave propagation. Additionally, investigations into anomalous solutions behavior in these circumstances were investigated. We will report about initial experimental findings of the fluid flow effect on the wavelength of the waves and the effect on the anomalous behavior.

1Funding Provided by The Physics Department of The College of Wooster

2:24PM G2.00003 The physical nature of Primary battery, LIU YUHONG, 13811867266, HAN YONGQUAN, 15611860790 — The reaction mechanism of the primary battery is that the sulfate ion in the copper sulfate solution is easier to grab the zinc ion combination in the zinc. Sulfate ions grab the zinc ions in zinc flakes, which is the process of plasma formation. The “zinc ions” in the zinc move toward the surface of the zinc sheet (the surface that is soaked in the copper sulfate solution). The zinc sheet and the copper sheet are connected by wires and are a unified conductor. The “zinc ions” move toward the surface of the zinc rod and form zinc. Positively charged, negatively charged copper plasma. The power plasma is transmitted in the solution. Copper and zinc bipolar exist in dilute CuSO4. Since zinc is more active than copper, it easily loses electrons, and zinc is oxidized into Zn2+ to enter the solution. Since the speed of the current is the speed of light, it is much faster than the speed of chemical reaction. Therefore, the lost electrons of the zinc film can only pass through the wire flowing to the copper sheet. The Cu2+ in the solution acquires electrons from the copper sheet and is reduced to copper, the power source is the plasma, and the current is the transmission of the power plasma in the conductor.

2:36PM G2.00004 Chromospheric Emission Lines: Rules of Formation, PIERRE-MARIE ROBITAILLE, Ohio State Univ - Columbus — In this work, for the first time, it is reported that strong metallic chromospheric emission lines (306-900 nm) are not random in origin. The following rules apply: 1) Strong lines have at least a single unpaired electron in the lower energy state reached (H, He I, Ca II H K, Cal triplet at 849-866 nm, all excited He I singlets and triplets, Mg I triplets at 516-518 nm, O I triplet at 777 nm are examples); 2) Line intensity does not result from random absorption-emission and temperature arguments as currently accepted; 3) Condensation reactions are involved as H is delivered through a metal hydride (e.g. H2, CaH, OH, FeH) to a condensed hydrogen structure (CHS), like spicules (e.g. CHS + MH → CHS-HM* → CHS-H + M* → CHS-H + M + hv); 4) Such processes distort the intensities of the lines relative to actual chromospheric abundances and laboratory values; 5) The transition electron is the one making the bond in the metal hydride; 6) Transitions which involve an electron in a closed shell ground state do not occur. The first exception appears to be recorded 4s2 transitions. Several of these may be improperly assigned, although many are real; 7) He lines (50.8-59.14 nm) arise by capture of H+ from He and delivery to a CHS. H+ release from HeH+ leads to a 1s2 ground state on He. This is the second exception; 8) Two electron transitions from a d-shell ground state implicate delivery of molecular hydrogen, whereby two paired electrons in the d-shell act to create a transient π-back donation molecular shell and the two hydrogen molecule electrons contribute a σ-donation (consider: 415.964 nm in ApJSS, 1968, 150(17), 1-364, which if Ti I as recorded, originates from 3d6²D⁴s → 3d4s⁵p⁴p).

2:48PM G2.00005 Contact Interaction and Kronig-Penney Model in PT Quantum Mechanics, FOSTER THOMPSON, HARSH MATHUR, Department of Physics Case Western Reserve University, KATHERINE BROWN, Department of Physics Hamilton College — We study two simple models of PT quantum mechanics that provide insight into the propagation of light through suitably engineered PT symmetric optical structures. We introduce the PT quantum mechanics analog of a delta function potential and analyze its bound and scattering states. This model can support up to two bound states (one more than the textbook delta function) and these states undergo the phenomenon of PT symmetry breaking wherein the two bound state energies degenerate and become a complex conjugate pair as parameters in the model are varied. The scattering states are also found to show PT symmetry breaking as the scattering phase shifts (which are no longer constrained to be real by unitarity) become complex. A scattering resonance develops with the onset of PT symmetry breaking in the bound states. The Kronig-Penney model of solid state physics is a one dimensional comb of delta functions. Here we consider a PT symmetric crystal formed by a periodic array of PT symmetric delta function potentials. We find PT symmetry breaking and novel wave propagation phenomena in these simple models of PT symmetric crystals.

3:00PM G2.00006 Coarse-grained model for a motor protein on a microtubule, JUTTA LUETTOMMER-STRAHMANN, MANSOUR ALANAZZI, Department of Physics, The University of Akron, Akron, OH 44325-4001 — The function of cells relies on the transport of substances within the cell. In eukaryotic cells, active transport by motor proteins moving on a substrate plays an important role. The goal of this work is to model a motor protein walking on a microtubule. For the microtubule, we employ a combined micromechanical/interaction site model from the literature. This allows us to calculate deformations of microtubules with finite element methods and map the results to an interaction site model that includes details about the microtubule structure, for example a seam along the length of the microtubule. The motor protein is represented by a coarse-grained model that was developed in earlier work. In this work, we perform Brownian dynamics simulations of the walker on a fixed microtubule substrate. Calculations of average displacements of the walker show that the efficiency is lower than in biological systems and can be improved by adjusting protein model parameters. In agreement with recent experimental observations, we also find that the protein walker does not cross the seam of the microtubule.
2:00PM G3.00001 Single photon transmission in disordered waveguide QED in the presence of chiral couplings

2:12PM G3.00002 Lessons learned from the observation of harmonic generation in ultrastrongly coupled polaritonic matter

2:24PM G3.00003 Further Evidence for Stiff Symmetry Energy from Wide Isovector Aura

2:36PM G3.00004 Nonminimal Lorentz Violation in Electrodynamics and Applications

2:48PM G3.00005 Using Uncorrelated and Correlated $\chi^2$ Fitting to Constrain Transfer Cross Sections

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