2018

CUWiP

IOWA STATE UNIVERSITY

Poster Session

Saturday, January 13, 2018

3:30PM—4:30PM

First Floor Lobby, Scheman

Poster 1

Solar PV and Interactive Education

Gaither, Sarah
North Central College

Solar PV technology is decreasing in cost and increasing in popularity worldwide. However, there are still many individuals who do not understand this technology, even on college campuses. Education plays a very important role when it comes to the future of renewable energy. Interactive displays are a great way to engage a campus and its visitors in learning. An interactive display was created at North Central College by a physics undergraduate student to illustrate how solar PV technology works using a solar panel and colored LEDs. It was designed to illustrate the spectral response of solar PV panels. With the rising interest in solar PV, this shows possible future consumers the science behind their design. This session will provide the tools needed to create a similar design on campuses to display the renewable technology available.

Poster 2

Exploring the Transient Optical Sky with LSST

Blaum, Jacqueline
Iowa State University

The night sky appears to be calm and static to the human eye; however, this calm is only apparent. Through the use of the Large Synoptic Survey Telescope (LSST) under construction in Chile, we will be able to observe an extremely variable sky with tens of thousands of transient sources detected each night. These transient events, which include supernovae and Gamma-Ray Bursts, can last for seconds, days, or even months. In the past, searches for transients in the night sky often have involved looking for radiation received for a certain period of time that is characteristic of a certain type of transient. A problem exists in that transients could be active on timescales that have not yet been examined; therefore, in order to create a more thorough search, a method without the restriction of timescales should be used. A timescale-free algorithm such as this has already been developed by Dr. Giacomo Vianello at Stanford University in order to locate transients that last for various durations. Here we develop a new pipeline based on a variant of this algorithm, tailored to LSST data. We have evaluated the performance of this pipeline using simulations and found that it can find both faint and bright transients on multiple timescales, without prior assumptions.

Poster 3

HESS J1844-030: A New Gamma-Ray Binary?

McCall, Hannah
Washington University in St. Louis

Gamma-ray binaries are comprised of a massive, main-sequence star orbiting a neutron star or a black hole that generates bright gamma-ray emission. Only six of these systems have been discovered. Here we report on a candidate stellar-binary system associated with the unidentified gamma-ray source HESS J1844-030, whose detection was revealed in the H.E.S.S. galactic plane survey. Analysis of 60 ks of archival Chandra data and over 100 ks of XMM-Newton data reveal a spatially associated X-ray counterpart to this TeV-emitting source (E>10^12 eV), CXO J1845-031. The X-ray spectra derived from these exposures yields column density absorption in the range nH = (0.4 - 0.7) x 10^22 cm^-2, which is below the total galactic value for that part of the sky, indicating that the source is galactic. The flux from CXO J1845-031 increases with a factor of up to 2.5 in a 60 day timescale, providing solid evidence for flux variability at a confidence level exceeding 7 standard deviations. The point-like nature of the source, the flux variability of the nearby X-ray counterpart, and the low column density absorption are all indicative of a binary system. Once confirmed, HESS J1844-030 would represent only the seventh known gamma-ray binary, providing valuable data to advance our understanding of the physics of pulsars and stellar winds and testing high-energy astrophysical processes at timescales not present in other classes of objects.

Poster 4

Stripline Beam Position Monitor Testing at 3 GHz

Leitzke, Teagan
St. Norbert College

Poster 5

Verifying Muon Tracking and Energy Calibration in NOvA

Futch, April
Wheaton College

The NOvA experiment studies neutrino oscillations in order to learn more about fundamental neutrino physics. Neutrinos cannot be detected directly, so it is important that the algorithms used to track and measure the energies of charged particles produced by neutrino scattering are accurate. In NOvA, it is especially important that muon energy measurements are reliable because muons are also used to calibrate the far detector. This project aims to check muon tracking and energy calibration. This is done by running the tracking algorithm on cosmic ray muons, selecting a controlled sample of tracks, simulating identical particles, and comparing the data and simulation tracks. A 1% difference between dE/dx in data and simulation tracks is found. None of this difference results from the hits used for detector calibration, indicating that calibration is being done correctly. More work needs to be done to determine the cause for the discrepancy. This work was supported by NSF REU grant PHY-1460882 and the Indiana University Physics REU Program.

Authors: April Futch and Mark Messier

Poster 6

Fabrication of a ZnO/Graphene Nanocomposite by Ultrasonic Homogenization

McLain, Avery
University of Wisconsin-La Crosse

Transparent conductive materials have become ubiquitous to our everyday lives with numerous technological applications including harvesting solar energy, personal electronic devices, and biomedical sensors. The current most commonly utilized transparent conductor is indium-tin oxide (ITO), but indium is as rare in the Earth's crust as silver and costs about the same. Additionally, indium is toxic to blood, kidneys, the reproductive system, liver, heart, upper respiratory tract, skin, eyes making it a possible environmental hazard if not properly disposed of or recycled. Obviously, more cost effective, environmentally friendly materials must be developed which, ideally, can be fabricated using conventional manufacturing tools and processing techniques. Recent research has focused on employing zinc oxide (ZnO) and graphene as transparent conductors with each falling short of being a replacement for ITO. While ZnO is inexpensive, environmentally friendly, and easily coats large surfaces, it is resistive in its as-deposited form and must be alloyed, often with indium, to reduce the resistance of the film; a requirement which greatly increases production costs. Graphene is also inexpensive as it consists of sheets of carbon only one atom thick. This makes graphene highly transparent and exceptionally conductive, but graphene requires a metal support on which to be deposited, and this metal layer must later be etched away. The result is that graphene sheets are rarely larger than a few microns in size making uniform coating of a surface difficult. The current study uses ultrasonic homogenization to fabricate composite ZnO/Graphene materials on the nanoscale. By carefully adjusting the homogenization time and power it should be possible to obtain nanocomposite materials which exhibit the beneficial properties of each constituent.

Poster 7

Designing an Affordable Mobile Tracking System for Communication with a Medium Earth Orbit Satellite

Park, Soomin Shannon
University of Illinois-Chicago

We designed a tracking system to be used in maritime mobile satellite communications. Position is updated each second using a GPS antenna. To maintain the orientation of an antenna on a naval vessel, the instantaneous heading of the object must be known. Utilizing low-cost GPS units, we designed a tracking system to be used in maritime mobile satellite communications with two solutions. Our first method determines heading by implementing a least-squares model on a regular N-gon by using multiple GPSes. Our second method uses a time differential with a single GPS unit to determine heading and the uses signal strength of the satellite received by the antenna to correct any errors from the sensors. We tested the multiple-GPS method and time differential method with a satellite connection to the Omnispace F2 satellite at the USEI Teleport in Brewster, WA, to evaluate their performance in a simulated scenario. Although non-correlated systematic errors in the low-cost GPS receivers made the multiple-GPS model impractical, the time-differential method was able to maintain a satellite lock for the majority of a simple test course. The reliability of this solution may be further improved using a gain-based correction algorithm.

Authors: Key Peter Dong, David Beering, Harrison Carcione, Joseph Hutter, Gina Jiang, Charles Kuch, Soomin Park, Advai Podduturi, Peijing Xu

Poster 8

Raman characterization of microcrystals grown on monolayer graphene

Sun, Grace
University of Illinois at Urbana-Champaign

Strain can be calculated from graphene's Raman signatures, and can be potentially used to measure the force exerted by crystals grown on graphene. To do so, monolayer graphene was transferred to a glass substrate, onto which titania microcrystals were deposited via micro-pipette or grown via chemical reaction under autoclave conditions. The resultant samples were Raman-characterized before and after crystal growth. In the first round of experiments, graphene delaminated from the glass substrate over the course of three days during the autoclave procedure, although the grown titania produced clearly defined spectroscopic signatures. Micro-pipette deposition also yielded similar quality spectra containing both graphene and titania, even though the microcrystals were too amorphous to be ideal.

Poster 9

Indistinguishability of Single Photons from Dissimilar Light Sources

Teng, Yanting
University of Illinois at Urbana-Champaign

Quantum information science has great potential to transform current cryptography technology by encoding information in quantum states. While there are challenges such as decoherence of the states, they are worth overcoming because quantum cryptography will provide safer communication. One requirement for the realization of a quantum network [H.J. Kimble, Nature 453 , 1023-1030 (2008)] is indistinguishability of single photons. In this research, we aim to demonstrate indistinguishability of single photons that are emitted from two dissimilar sources, namely a non-linear crystal and a quantum dot. We report our preliminary data from Hong-Ou-Mandel experiment (Figure 1) used to test indistinguishability of single photons from the crystal and the quantum dot sources. We also present the analysis of single photon quality by measuring the correlation function g (2) (0) of 0.17.

Authors: Yanting Teng , Chris Müller , Tim Kro , Andreas Ahlrichs and Oliver Benson

Poster 10

Investigation of the Hydrodynamic Forces Acting on a Model of a Moving Hand

Gregorio, Elizabeth
Hamline University

The greatest amount of direct propulsion during swimming comes from the force exerted by the hand. During the pull phase of the stroke it is possible for a swimmer to create a higher effective surface area by slightly spreading their fingers. This phenomena occurs because of the dynamic forces acting on the hand while moving in water. This has been well studied in literature, however, to the knowledge of the authors there has been no investigation done with experiments in a water tank in conjunction with numerical trials. Therefore, this project is an investigation of a comparison of these methods. The computational software ANSYS Fluent was used to numerically study a simple model of the four fingers (not including the thumb), held with different spaces between them. Analysis was done using pressure differences and drag coefficients. These values were calculated for models of each spacing: no space (0.00cm), small space (0.20 and 0.30cm), and large space (1.00 and 1.50cm). These calculations were then compared to the values calculated from the data collected during physical trials, using a 3D printed model held at the same spacings. Evidence of the occurrence of the phenomena was found when small spacing was used in the water tank and confirmed by the computational results. Ongoing work includes an investigation of these methods for a reconstructed 3D image of a hand held at approximately the same spacings.

Authors: Elizabeth Gregorio, Kevin Stanley"

Poster 11

Infrared Response of a Quasi-Crystalline Filter

Pedek, Samantha
University of Wisconsin-River Falls

The cosmic microwave background is the left over radiation, or relic radiation, from the Big Bang. Studying this faint microwave signature gives insight into the conditions of the early universe. In order to make precision measurements of the cosmic microwave background polarization, cryogenic detectors maintained at ~0.1 Kelvin are needed to operate the detectors. Background infrared radiation can warm the instrument and degrade its performance. This thermal radiation can be mitigated by using a series of infrared blocking filters. Traditionally, infrared metal mesh filters consist of several layers of a translationally symmetric tiling (e.g. squares or hexagons) are used to block radiation in large apertures. This approach can lead to diffraction at large angles, which, if present, can also create a pattern in the angular response. This decreases the angular resolution and beam symmetry, which is vital for polarimetry measurements. The main goal of this project was to design a filter with a different geometric tiling approach that has the potential to decrease diffraction at large angles. Instead of using a Cartesian tiling, this study uses a rotationally symmetric tilling of pentagons which cannot be tiled in two dimensional translational space. The resulting tiling is referred to as a non-periodic quasi-crystal. In order to better understand the optical behavior of the quasi-crystalline tiling, a simplified version of the filter was primarily studied due to computational restrictions. The quasi-crystalline filter has been fully designed and is awaiting fabrication.

Poster 12

Characterization of Uniformity of MoCu Bilayers

Gruenke, Rachel
University of Wisconsin-Madison

With the goal of developing thin-film superconducting detectors called transition edge sensors (TES) for high resolution x-ray spectroscopy, our group deposits molybdenum-copper bilayers on silicon wafers by ion-assisted e-beam evaporation. The bilayers are then ion-milled to create trenches through the copper layer. The trench mask patterns hundreds of die that each contain many TES detectors. To ensure that devices made on the periphery of *the wafer are patterned similarly to the devices made in the center of the wafer, we need to check that the deposition and etching processes maintain uniformity in device thickness, roughness, resistivity, and purity. Therefore, this project checked the uniformity of test wafers in four ways: (i) measuring the Cu resistivity as a proxy for thickness after ion-milling without a mask, (ii) scanning step heights for Cu and Mo films that had ben ion-milled with a mask using a high-precision profilometer, (iii) analyzing the roughness of the bilayers before and after ion-milling using the same profilometer, and (iv) dip-testing samples to find the residual-resistance ratio (RRR) of the Mo and Cu across the wafer as a proxy for transition temperature and purity, respectively. From this data, we could determine that the entire wafer was uniform to a standard that would allow every device work properly.*

Authors: Rachel Gruenke, Dan McCammon, Felix Jaeckel, Kari Kripps

Poster 13

Development and Characterization of Nanomaterials for Photothermal Therapy

Brennan, Megan
Hamline University

Cancer is a devastating diagnosis, and a treatment that consistently works has yet to be found for it. One promising, up-and-coming strategy involves injecting nanoparticles into the tumor, and then heating with a laser to 7 degrees Celsius above body temperature, as is required to kill cells. Preliminary findings have suggested that the best materials for this purpose are semiconductors with a band gap near 1.53 eV. Graphene has potential as a photothermal agent due to its ability to absorb energy, its low cost, and its lack of environmental and health hazards. Black phosphorus (BP) is also a strong candidate for this application, due to its adjustable band gap of 0.3-2.0 eV, however, the substance degrades rapidly due to oxidation when exposed to ambient conditions. Despite being discovered over one hundred years ago, the potential applications of BP are largely unexplored. Here, BP is used to synthesize quantum dots, which are tested for their photothermal conversion efficiency. Also tested is a combination of black phosphorus and graphene, as well as graphene alone. The composite materials were dispersed in water and heated until they reached a temperature plateau with an 808 nm infrared laser. The temperature increase of each composite indicates its efficiency in converting infrared light into heat, and thus, its usefulness in treating cancer. Repeat heating tests were performed over a series of days to test the degradation of each composite. Preliminary results demonstrate that, of the three substances tested, graphene alone has both the highest temperature increase and the highest photothermal conversion efficiency.

Authors: Megan Brennan and Yan Shan (Lifeng Dong)

Poster 14

Using Raman spectroscopy to characterize topological insulator composition

Nelmark, Claire
The College of St. Benedict

Topological insulators (TIs) have important implications for future electronic devices, particularly those combining spin-based logic and memory. As materials, they are insulating in the bulk, yet have spin-protected conducting surfaces which offer new possibilities in the realm of spintronics. By manipulating the electron spin state, these materials may lead to more energy efficient logic and memory architectures. Bi2Te3 and Sb2Te3 are realizations of topological insulators, but need to be combined into a compound crystal, (Bi,Sb)2Te3, to avoid non-ideal conducting bulk states. In this work, we used Raman spectroscopy to characterize (Bi,Sb)2Te3 thin films synthesized using molecular beam epitaxy. The changes in phonon modes with the composition of the film are represented by shifts in the peaks of the spectra. By using samples with known compositions, we aim to create a secondary calibration standard by which to quickly characterize future samples. This will provide an alternative to other, less efficient methods, such as time-of-flight secondary ion mass spectroscopy.

Poster 15

Comparison of Water Vapor Observations in the Asian Monsoon UTLS Region during StratoClim

Singer, Clare
University of Chicago

As part of the StratoClim campaign in July/August 2017, the Chicago Water Isotope Spectrometer (ChiWIS) made water vapor measurements from the mid-troposphere through the lower stratosphere (up to 20 km altitude). We compare multiple in-situ measurements with remote sensing observations to validate measurements. Preliminary analysis suggests that ChiWIS provides high-precision in-situ sampling of UTLS water.

Authors: Clare E. Singer, Benjamin Clouser, Dylan C. Gaeta, Elisabeth J. Moyer

Poster 16

Characterization of Filament Damage on Externally and Internally Etched Bi2Sr2CaCu2O8-x (Bi-2212) Superconducting Wires after Tensile Strain

Egner-Schnitzler, Jordan
University of Wisconsin-Eau Claire

Recent increases in the critical current density of Bi2Sr2CaCu2O8-x (Bi-2212) composite wires have driven interest in superconducting magnet applications for this material. However, the round-wire composite material is comprised of brittle filaments in a soft silver matrix, leaving the wire susceptible to filament damage during magnet operation. In this study, Bi-2212 wires were strained on a Cu-Be dogbone in an Instron tensile tester and then chemically etched (externally or internally) to reveal filament damage. Damage was specified as a function of percent strain (ranging from no strain to 0.8% strain) applied by the Instron to the wires. After undergoing an external or internal chemical etch process, scanning electron microscopy (SEM) was utilized to analyze the filament damage in each sample. In general, as the amount of strain applied to the wires increased, the observed filament damage increased. Results showed there was more damage present on the outside of the wire compared to the inside. This new understanding of how damage evolves within Bi-2212 wires establishes a better knowledge of how damage progresses through the wires during mechanical performance.

Acknowledgments: This work was financially supported by the U.S. Department of Energy (DoE), Office and High Energy Physics (OHEP), award DE-FG02-13ER42036, and benefited from the support of the Materials Science & Engineering Center at UW-Eau Claire.

Authors: J.A. Egner-Schnitzler, L.J. Jarocki and M.C. Jewell.

Poster 17

Measurement-based control of quantum chaos

Greenfield, Sacha
Carleton College

Chaotic systems display exponential growth of error over time. We present a particular case of chaos in a theoretical model of a quantum mechanical Duffing oscillator, in which different values of the measurement angle give rise to or suppress chaos. While quantum properties are typically understood as suppressing chaos, we explain how quantum measurement destabilizes classically periodic behavior. This work could be extended to control other types of quantum chaos which do not have periodic classical analogues, which could have practical relevance as nanotechnologies approach the scale of quantum effects.

Authors: Sacha Greenfield, Jessica K. Eastman, Arjendu K. Pattanayak, André R. R. Carvalho.

Poster 18

Spatial Frequency Modulated Imaging of Real-Time Laser-Matter Interaction

Lanaghan, Clare
Iowa State University

Laser modification of materials or biological systems would benefit from imaging systems that are able to quantify the interaction in real-time. One of the important constraints for such an imaging system is that it must be robust against optical scattering, as interactions may take place deep within a scattering material.
We demonstrate a novel new imaging modality that enables real-time characterization of laser ablation from a 10.6µm CO2 laser. Our system uses confocal spatial frequency modulation imaging with a rotated reticle modulation mask that can show real-time changes and make two and three dimensional images of the material. Single element detection is used to aid in mitigating scattering effects of the optical signal, and an 800nm excitation wavelength enables detection down to millimeter depths in glass and plastic scattering systems. The resolution of the system was tested by imaging line-pair targets; line-pairs down to 20m were observed. The contrast in images taken of a fingerprint on acrylic and microfluidic channels in glass, which are both essentially phase targets, suggests that the system is capable of generating contrast based on phase differences in the target. We are working on new models of the microscope to help explain the apparent phase contrast.

Poster 19

Single Crystal Solution Growth of (Fe1-xCox)2B

Neubauer, Kelly J.
Gustavus Adolphus College

The magnetocaloric effect is usually quantified by a negative variation of entropy when applying field at constant temperature. An inverse effect can also be observed near spin reorientations. We describe the solution growth method used for the synthesis of single crystals of Fe2B alloys with Co substitutions. We can control the spin reorientation temperature using Co doping. The transition occurs in the range 300-0 K for substitutions in the range 11-13%. We report on an inverse magneto-caloric effect at this transition.

Poster 20

Calibration of Temperature Sensors in Preparation for the 2017 Total Solar Eclipse

Walter, Alynie
St. Catherine University

In preparation for the 2017 total solar eclipse, St. Catherine University developed a calibration protocol for the temperature sensors flown during thermal wake boom experiments. The calibration method used a standard two-point technique that corrected each individual sensor for both slope and offset errors using a high quality NIST certified thermocouple as the temperature standard. Our method is not absolute but corrects each sensor relative to the NIST standard so that we feel some confidence that individual sensor variations are mitigated. In preparation for the eclipse, calibration curves were generated for over 200 individual digital and thermistor temperature sensors.

Authors: Erick Agrimson, Kaye Smith, Rachel DuBose, Vina Onyongo-Robshaw, Ana Taylor, Alynie Walter, Peace Sinyigaya, Grace Maki, Rachel Lang, Brittany Craig, Gordon McIntosh, James Flaten.

Poster 21

Encapsulation and Reliability of Flexible Organic Photovoltaic Cells

Arneson, Claire
University of Wisconsin-Eau Claire

As energy usage around the globe continues to rise, the time dedicated to searching for cost- effective renewable energy schemes rises as well. Photovoltaic cells, which are already on the market, have significant commercial drawbacks, including their heavy weight and slow and expensive manufacturing process. Organic photovoltaic cells (OPVs) are uniquely qualified for high-speed and cost-effective manufacturing processes, such as roll-to-roll manufacturing. The efficiency of OPV devices, however, is significantly decreased by the presence of defects formed during device fabrication and degradation caused by exposure to water vapor. In order for OPV roll-to-roll manufacturing to be realized in a commercial market, while maintaining high device efficiency, a flexible OPV encapsulation scheme that has a water vapor transmission rate of less than 10-6 g/m2/day must be designed and tested. This research studied the optical and mechanical properties of various films for use in OPV encapsulation.

Poster 22

Evolution of the Circumgalactic Medium in a Simulated Dwarf Galaxy

Arredondo, Nicole D
Grinnell College

The circumgalactic medium (CGM) evolves through galaxies' expulsion of material into the surroundings. Gas in the CGM also accretes onto the galaxy which it surrounds. The history of these close interactions between a galaxy and the CGM is difficult to study observationally, leading to the use of simulations. This project explores the evolution of the CGM of a simulated dwarf galaxy (Mvir = 1.8 x1010M?) from z = 3 to z = 0 . We used two forms of analysis on our simulations. We extracted information such as gas temperature and gas surface density directly from the simulations. Then, in order to mimic data that would be received from observational research, we generated synthetic absorption line spectra along lines of sight. Our analysis shows that the CGM becomes more orderly over time. Gas movement at high redshift has much higher variance than at z = 0. We observe that there is a trend towards the reduction of gas temperature over time, which is reflected in the ionization levels of the gas. In addition, since z = 1, we see an increase in the amount of metals at large radii. This increased metallicity extends far into the CGM, suggesting high velocity outflowing gas from the galactic disk.

Poster 23

Intrinsic Flow Behavior During Improved Confinement in MST Reversed-field Pinch

Tan, Elizabeth
Wheaton College

We used ion doppler spectroscopy to measure impurity ion flow velocity in high-current plasmas during periods of improved confinement (PPCD). Velocity measurements throughout the core reveal that the poloidal flow near the core is larger on outboard positions compared to the inboard positions. Toroidal flow velocity near the axis is the fastest and does not decrease like other positions as PPCD proceeds. Possible reasons why the on-axis flow exhibits different behavior are discussed. This work has been supported by the US DOE and the Wheaton College summer research program.

Authors: E. Tan, D. Craig, J. K. Anderson, J. Boguski, T. Nishizawa, M.D. Nornberg, B. Schott, and Z.A. Xing.

Poster 24

Gigayear timescale instability in multiplanet systems

Chapman, Kathryn
University of Chicago

This project, like most exoplanet queries, holds its roots in our own Solar System. At first glance the Solar System appears to be relatively stable, but it is in fact chaotic. Recent work (Laskar and Gastineau 2009) has shown that there is a potential for Mercury to to become unstable through angular momentum transfer from the other planets (Mercury has a low mass and a small semi-major axis, so a relatively small change in the other planets can have a drastic effect on its orbit) and be ejected from the solar system. This then raises the question: if our own planetary system has the potential to become unstable, what about other planetary systems?
It is already common practice to test the stability of newly discovered planetary systems with short timescale (104 - 108 years) integrations. Unfortunately, integrations of this length are not long enough to catch secular instabilities, which only appear on 109 timescales and are theorized to be responsible for the instability in the solar system. A simple solution to this problem would be to simply run 109 timescale integrations, but such simulations can take months to finish even with significant computing power. The main goal of my project is then to develop less time consuming methods to assess the secular stability of multi-planet exoplanet systems, and further identify what parameters of such systems are precursors to instability which may only present itself 109 years in the future.

Poster 25

Geocoronal Hydrogen Observations

Ranabhat, Arianna
University of Wisconsin-Madison

We are observing hydrogen in the upper atmosphere, specifically the thermosphere and exosphere. Hydrogen in this region is a byproduct of chemical reactions of gaseous H2O, CH4, H2, OH, and CH2O, some of which are greenhouse gases. It is predicted that an increase in methane in the lower atmosphere will increase hydrogen levels in the upper atmosphere. Studying hydrogen in the upper atmosphere gives a more complete picture about the mechanics of the entire atmosphere. We modeled how the solar cycle, a source of natural variability, affects hydrogen Balmer-alpha emission in the upper atmosphere. We used the Wisconsin H-a Mapper Fabry- Perot (WHAM) interferometer in Kitt Peak, Arizona and the "pre-WHAM" interferometer in Pine Bluff, WI to measure emission intensities at specific altitudes during the solar cycle. To reduce uncertainty, observations are taken on clear moonless nights with zenith angles less than 50 degrees. Using the Voigt-fit spectral fitting code and calibration, we plotted the Balmer-alpha emission versus shadow height for the 2006 solar minimum and fit a fourth degree polynomial to the data. We will continue plotting solar minimums and maximums in order to create a longer term data sets and analyses.

Poster 26

Fluorescence Spectra and Decay Time Measurements of Sm-doped Bismuth Boro-Tellurite Glasses

Jacobson, Natalie
Western Illinois University

Glasses doped with rare earth (RE) are important materials for a variety of applications including solar energy conversion, optical fibers for fast communications, and light emitting diodes. Among the several RE ions used, Samarium ions (Sm3+) are of particular interest due to their efficient emissions in both the visible and near-infrared (NIR) wavelength regions of light. Therefore, Sm3+ doped glasses have attracted considerable attention in the field of photovoltaics. The choice of the host glass is extremely important because the light emission characteristics of Sm3+ are critically affected by the properties of the host glass. Pure borate glasses are ideal host materials with low melting point, high thermal stability, and excellent RE ion solubility, but they have high phonon energy, making them unsuitable for optical applications. The addition of heavy metal oxides such as lead

and bismuth oxides lowers the phonon energy of borate glasses considerably and thereby enhances their potential as host materials. Bismuth borate glasses are interesting glass forming systems which exhibit a considerable range of variation in optical properties as a function of glass composition. Adding a ternary component to the glass like tellurium oxide is further expected to lower the phonon energy of these host glasses. Can the addition of tellurium oxide to bismuth oxide glasses improve the fluorescence emission properties of Sm3+ ions? Therefore, we propose to prepare a series of Sm-doped bismuth boro-tellurite glasses and study the fluorescence spectra and decay time measurements to understand the effect of tellurium oxide on the optical properties of Sm3+ ions. Fluorescence decay time measurements are especially important for this study because it can be used for estimating the quantum efficiency of Sm3+ ions.

Poster 27

Cataclysmic Variable Stars in the Sloan Digital Sky Survey

Smiley, Sam
DePaul University

The purpose of this study is to identify Cataclysmic Variables (CV) using spectroscopy and photometric data. CVs are useful for studying the plasma physics in extreme conditions such as the high temperatures and strong magnetic fields seen in CV accretion disks. They are also critical for understanding the evolution of binary stars, both in the field and in globular clusters. This project used photometric and spectroscopic data from the Sloan Digital Sky Survey (SDSS) to identify and classify CVs. 6,000 objects were selected based on multi-color criteria and analyzed using spectral data. Approximately 1% of the objects in the sample were classified as CVs in the SDSS pipeline. Of these, 11% were found to have typical spectra while the remaining 89% had spectra inconsistent with standard CVs.

Poster 28

Vibrational Dynamics of Orb-Webs

Rix, Jillian
Grinnell College

Spiders hunt by detecting and interpreting web-based vibrations resulting from the presence of prey. However, little is known about how prey signals are conveyed through planar string structures. Furthermore, spider webs are difficult to study due to their fragility, scale, and unique tensile properties. We build a set of artificial, scaled-up webs to mimic the vibrational properties of those found in nature and load devices to assist in their characterization. Moveable 3D printed tensioning devices enable efficient, reproducible and variable web setup.

Poster 29

Boldly go where no plant has gone before

Sinyigaya, Peace
St. Catherine University

While Mars provides potential for life, it is not currently capable of supporting human life without adaptations. Mars has a very different environment than Earth, which varies in temperature, humidity, amount of sunlight, elements in the atmosphere, and lack of soil. Since the two environments are so different, it is necessary to find a way to grow plants on Mars to produce food and to increase the amount of oxygen in the atmosphere to support human life. Hydroponics is a method of growing plants without using any soil and instead uses a liquid medium to grow the plants. This method of growing plants has a high potential to work on Mars. Using the hydroponic system, we grew two kinds of plants: basil and parsley. The system we created also controlled the amount of light, the nutrients the plants received, and used an arduino controlled solenoid valve to adjust the quantity of water they were growing in. While the health of the plants fluctuated, we learned our hydroponic system has potential to work on Mars once the various components are mastered.

Poster 30

Calculating Galactic Distance Through Supernova Light Curve Analysis

Glanzer, Jane
Minnesota State University-Moorhead

The purpose of this project is to experimentally determine the distance to the galaxy M101 by using data that was taken on the type Ia supernova SN 2011fe at the Paul P. Feder Observatory. Type Ia supernovae are useful for determining distances in astronomy because of their ability to be standardized. Comparing the apparent magnitudes to the absolute magnitudes allows a measurement of the distance. The absolute magnitude is estimated in two ways: using an empirical relationship from the literature between the rate of decline and the absolute magnitude, and using sncosmo, a python package used for supernova light curve analysis that fits model light curves to the photometric data.

Poster 31

Calculating Accessible Regions of the Parameter Space of Phase Transition Stochastic Gravitational Wave Background to Next Generation Detectors

Fitz Axen, Margot
University of Minnesota-Twin Cities

Cosmological phase transitions are predicted in many scenarios beyond the standard model, occurring when regions of the universe transition from one ground state to another. First order phase transitions proceed by the nucleation of bubbles of a new phase which expand and collide with each other, giving rise to a significant stochastic background of gravitational waves. While these gravitational waves are unlikely to be detectable by current ground based detectors such as LIGO, they are a good target for the proposed space based detector LISA and next generation ground based detector Cosmic Explorer. By calculating the stochastic background for a range of phase transition parameter values, we are able to determine the regions of the parameter space which are accessible to current LISA and Cosmic Explorer projected sensitivities.

Poster 32

Gravitational Phenomena in Saturn's F Ring

Seelinger, Katharine
Beloit College

The F ring of Saturn lies outside the main rings of Saturn and is known to lie on Saturn's Roche Limit. As a result, the F ring particles experience numerous collisions that create dust clouds that reect a significant amount of light, referred to as ""clumps."" The Cassini spacecraft captured various images of the F ring during a ring plane crossing (RPX) in December 2006 [with a the narrow angle camera (NAC)]. Our research group at Beloit College has documented and tracked these images, and analyzed this data to nd patterns within the clumps' movements. We subtracted the background brightness waves from each image to create more accurate brightness proles and accurately and the horizontal position to track the trajectory of clumps.

Authors: Katharine Seelinger, Parveen Narula, Alex DePillis, Britt Scharringhausen.

Poster 33

Lightly Ionizing Particles with CDMS

Ristani, Gina
University of Minnesota-Twin Cities

What lightly ionizing particles (LIPs) are, how CDMS detectors work and how that allows us to predict what a LIP signature would look like. Understanding the range of charge fractions we can explore.

Poster 34

Investigating the effect of beta-amyloid aggregates on the unfolded protein response pathway using super-resolution microscopy

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Alzheimer's disease (AD) is one of the most common ailments to affect the aging population globally. AD presents as a progressive neurodegenerative disease that leads to memory and cognitive failure, and is classified as a protein misfolding disorder characterized by two neuropathological hallmarks: amyloid beta (A?) plaques and neurofibrillary tangles. These protein aggregates can alter the functioning of various organelles, including the endoplasmic reticulum (ER). The unfolded protein response (UPR) is an intracellular signaling pathway that detects ER stress and activates a transcriptional program to contain, manage and reverse ER stress. Recent examinations of post-mortem brain tissue of AD patients have revealed evidence of ER stress and provided a direct link between AD and the UPR.

Currently, the pathophysiological mechanisms of AD and other similar protein misfolding disorders are poorly understood. While numerous distinct models of pathological mechanisms have been proposed and described involving the roles of UPR and A? in the pathophysiological process of AD, the relationship between the factors remains unclear. In this study, super-resolution microscopy techniques are used to study whether intracellular A? aggregates induce UPR by using a simplified, yeast model system of A? aggregation. Highly toxic strains of A? were subcloned into E. coli, then transformed into Saccharomyces cerevisiae. These strains were then visualized using photo-activated localization microscopy (PALM) to explore whether A?42 aggregates are found in the ER or in vesicles and if UPR activation is present. Activation of the UPR as a result of induced intracellular A? aggregates would demonstrate a link between intracellular A? aggregates and further support the UPR's involvement in the pathology of AD. The study is currently ongoing.

Poster 35

Iridium Island Formation on HOPG

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Island formation of Iridium on highly oriented pyrolytic graphite (Ir/HOPG) have been studied using scanning tunneling microscopy (STM), atomic force microscopy (AFM), and x-ray photoelectron spectroscopy (XPS). STM images of the Ir islands showed that the islands had a rectangular shape. This result was unexpected because the typical lattice structure of Ir is face-centered cubic (fcc), which should form close-packed hexagonal islands on the HOPG surface. The rectangular shape of the islands suggests that the Ir atoms form as a simple cubic (sc) lattice structure.

Poster 36

Variable Stars in the Field of TrES-3b

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The star field around the exoplanet TrES-3b has potential for finding unknown variable stars (stars whose brightness changes over some period of time). The field was observed over several nights using Minnesota State University Moorhead's Feder Observatory. A light curve for each star was created and is being evaluated for variability and periodicity. A python program is in development to help complete the analysis by automating some of the process. Several stars in the field appear to be variable and are being further analyzed to determine a period and to classify the type of variable.

Poster 37

Tracker Module Performance Analysis from g-2 Test Stand Data

Shamo, Violet
North Central College

The g-2 experiment aims to measure the anomalous magnetic dipole moment of the muon with greater precision than the current experimental value. Part of reducing the systematic error of this measurement is having a detailed understanding of each piece of the detectors. Our contribution was writing software in ROOT to analyze two types of performance data from testing the straw trackers. The plateau analysis helps to determine the operating voltage of the wires in the trackers by measuring the size of the signal generated from hits over a range of voltages. The output from the code helps to easily identify broken or tripped wires as well. We found the ideal detector operating voltage to be between 1500 V and 1550 V. The gain measurement code synthesizes the information from separate runs of simulated data at different voltages in order to find the relationship between gain and and operating voltage. The experimental setup to measure gain does not allow for true operating conditions, so this measurement must be extrapolated from several lower voltage points. Each of the 128 wires in the detector has a unique gain-voltage relationship. Though our code currently produces output containing all of the necessary information for these measurements to be useful, we would like to improve the quality and detail of our algorithms, which will be possible with more quantity and quality of raw data. We would also like to improve the functionality and efficiency of our code.

Authors: Violet Shamo, Tyler Weitzel, Dr. Paul Bloom.

Poster 38

Ultra-High Energy Neutrino Detection in Ice

Chipman, Shoshana
University of Chicago

When cosmic rays interact with the microwave background radiation left over from the Big Bang, they produce ultra-high energy neutrinos (UHENs). UHENs are detected on Earth when they interact with radio-transparent materials near the planet's surface (such as large deposits of sand, salt, or ice) and create a particle cascade. The Askaryan Radio Array (ARA) near the South Pole detects UHENs using the radio waves from neutrino/ice interactions. My research focuses on building Monte-Carlo simulations of neutrino interactions and the movement of these radio waves, and using those simulations to identify the most plausible models of propagation of radio waves in ice, and the correspondingly optimal placement of detector arrays.

Poster 39

Effect of Fe substitution on structural, magnetic and electron-transport properties of half-metallic Co2TiSi

Herran, Juliana
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The structural, magnetic and electron-transport properties of ferrimagnetic Co2Ti1?xFexSi (x = 0, 0.25, 0.5) have been studied, using density functional calculations. The experimental results showed that Co2Ti1?xFexSi (x = 0, 0.25, 0.5) crystallize in cubic L21 structures with partial disorder. We show that the magnetic moment of this material increases when Ti is substituted with Fe, which is consistent with experimental findings. Our calculations also indicate that the Co2Ti1?xFexSi compound remains nearly half-metallic for x ? 0.5. The Curie temperature is enhanced due to Fe substitution from 340 K for Co2TiSi to 780 K for Co2Ti0.5Fe0.5Si. The change in Fe concentration is also found to affect the lattice constant. In particular, increasing Fe concentration results in a decrease of the lattice parameter, consistent with the XRD results. The predicted large band gaps and high Curie temperatures much above room temperature make these materials promising for room temperature spin-based electronics (spintronic).

Poster 40

Experimental Demonstration of Magnetic Reconnection in a Laboratory Scale with Guide Field

Kim, Hyunsue
University of Wisconsin

Through a process called magnetic reconnection, the opposing solar wind and Earth magnetic fields annihilate and allow energetic solar particles to enter the magnetosphere. This energetic plasma can cause major disturbances to satellite communication networks and navigation systems, as well as electrical power grids. To better understand this process and prevent significant economic losses, NASA has launched the MMS Mission in 2015, a cluster of spacecraft which directly probes the reconnection sites in the magnetosphere. Though in situ measurements of reconnection in space are essential to our understanding of the process, the mission comes at a cost of over $1 billion. Thus, smaller laboratory experiments become essential to compliment the data acquired by MMS at relatively low cost. The Terrestrial Reconnection Experiment (TREX) currently aims to probe a similar configuration to dayside reconnection by adding a toroidal guide magnetic field, where under the right conditions, high frequency turbulent fluctuations are expected. Using a set of fast Langmuir probes to diagnose the fluctuations, the global structure of the plasma turbulence can be reconstructed. In this poster, an overview of the upgraded experiment and design progress of the fast Lprobe will be provided.

Poster 41

Self-Navigating Field Programmable Gate Array Robot

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University of Wisconsin Eau Claire

The goal of this project was to create an avatar robot that takes directions from a remote operator, but has the sensors and navigation algorithm to autonomously avoid local obstacles that impede the path chosen by the operator. Remote piloting of robots is difficult because the operator cannot always judge how close the robot is to obstacles. Driving the robot becomes easy when the robot has the capability to autonomously avoid the edges of objects in its path. This project developed a robot that can detect the edges of obstacles approximately two meters away using infrared distance (IR) sensors. Two-way audio and visual communication was incorporated with the help of a web cam and a microphone. This project takes advantage of a unique new program control board called a myRIO that is based on field programmable gate array (FPGA) technology.