XXXVIII

Annual

Rochester Symposium for Physics
(Astronomy & Optics) Students
SPS Zone 2 Regional Meeting

March 30, 2019

Department of Physics and Astronomy
University of Rochester
Rochester, NY 14627

Cosponsored by:
National Office of the Society of Physics Students; Department of Physics and Astronomy, University of Rochester; National Science Foundation (REU Program); Department of Energy

University of Rochester, March 30, 2019

Dear Participants:

Welcome to the 38th annual Rochester Symposium for Physics Students (RSPS). The RSPS was instituted to provide an opportunity for undergraduates to present an account of their own personal research at a meeting whose format was chosen to closely resemble those of professional scientific societies.

At these symposia, research projects are presented in talks or poster sessions by undergraduates representing many regional institutions. Topics include condensed-matter physics, atomic physics and optics, computational physics, astronomy, particle and nuclear physics, instrumentation and techniques, environmental physics, biological physics, medical physics, and educational physics. The abstracts of all the participants' papers are published annually in the RSPS proceedings and distributed to the participants. The information is also available on line at: http://www.pas.rochester.edu/news-events/rsps/2019/index.html

Students who present these talks can list their RSPS presentation(s) on their resumes and show the above web page in their list of publications as an "On-line Published Abstract". We encourage students to follow up on their research with the aim of giving a presentation at a regular American Physical Society (APS) meeting (which now also has a special session on undergraduate research), and eventually follow up with a publication in a regular journal, or in the APS Journal of Undergraduate Research.

At Rochester, the Department of Physics and Astronomy and the Institute of Optics are jointly running two National Science Foundation (NSF) funded Research Experience for Undergraduates (REU) sites. We encourage you to apply to one of these summer programs. Examples of research projects, talks, publications and awards won by our REU participants can be found on our REU Web page: https://www.pas.rochester.edu/undergraduate/reu/index.html

Your audience will include both students and faculty members and will provide you with the opportunity to address a knowledgeable and appreciative assembly of fellow researchers. Scientific research is an extraordinary activity. We certainly hope that many of you will decide to pursue careers that involve you intimately in mankind's greatest intellectual adventure, to comprehend nature. To quote Albert Einstein, “The eternal mystery of the world is its comprehensibility.”

Frank Wolfs (Chair RSPS)
Department of Physics and Astronomy
University of Rochester

LIST OF SPEAKERS

PRESENTER	TIME	ROOM
NATALIE ALLEN	10:30 AM	B&L 208
DIANA BATEMAN	9:30 AM	B&L 106
THOMAS BECKER	2:30 PM	B&L 109
LEESA BROWN	11:30 AM	B&L 109
NICO CARELLO	9:15 AM	B&L 109
KATELYN COOK	10:30 AM	B&L 208
KATELYN COOK	11:00 AM	B&L 109
KURT CYLKE	2:00 PM	B&L 106
JONATHAN DURBIN	9:00 AM	B&L 109
PETER GILMARTIN	9:15 AM	B&L 106
JADA HAWKINS-HILL	9:30 AM	B&L 109
BRIANNA HOLMES	10:30 AM	B&L 208
KASSIDY HOWARD	10:30 AM	B&L 208
TYLER KING	11:00 AM	B&L 106
JULIE LATTANZIO	11:15 AM	B&L 106
JESUS LOPEZ	2:00 PM	B&L 109
STEFANO MAINELLA	9:45 AM	B&L 109
JARED MALONE	10:30 AM	B&L 208
KYLE MASCARA	10:30 AM	B&L 208
DAVID MAYRHOFER	2:15 PM	B&L 106
MEGHAN MCDONOUGH	2:15 PM	B&L 109
MATTHEW MERCHANT	10:15 AM	B&L 109
RYAN MIKULEC	12:00 PM	B&L 106
SARAH OLANDT	10:30 AM	B&L 208
JOHN PIOTROWSKI	2:30 PM	B&L 106
YINGSI QIN	10:30 AM	B&L 208
SARAH REESE	11:15 AM	B&L 109
ADINA RIPIN	10:30 AM	B&L 208
LAUREN STEVENS	10:45 AM	B&L 106
SHANNON SWEET	11:30 AM	B&L 106
JACQUELINE VAN SLYCKE	10:00 AM	B&L 109
KATELYN WAGNER	10:15 AM	B&L 106

PRESENTER	TIME	ROOM
YUE WANG	11:45 AM	B&L 109
FAITH WILLIAMS	10:30 AM	B&L 208
MATTHEW WITHEY	9:45 AM	B&L 106
FATIMA ZAIDOUNI	10:00 AM	B&L 106
SAIYANG ZHANG	9:00 AM	B&L 106

XXXVIII – ROCHESTER SYMPOSIUM FOR PHYSICS (ASTRONOMY AND OPTICS) STUDENTS
SPS ZONE 2 REGIONAL MEETING

PROGRAM

8:00 AM – 8:45 AM: REGISTRATION AND POSTER SETUP (B&L LOBBY)

8:45 AM: WELCOME: PROF. FRANK WOLFS, UNIVERSITY OF ROCHESTER (B&L 109)

9:00 AM – 10:30 AM: SESSION IA. INSTRUMENTATION & EXPERIMENTAL TECHNIQUES (B&L 109)

SESSION CHAIR: PROF. MARK YULY, HOUGHTON COLLEGE

9:00 AM	**Construction of a Low-Speed Closed-Return Wind Tunnel** Jonathan G. Durbin, Houghton College
9:15 AM	**3D Laser Object Scanner** Nico Carello, Siena College
9:30 AM	**Calibrating Three Axes Accelerometer for Alzheimer's Research** Jada Hawkins-Hill, Dr. Matthew Bellis, Siena College
9:45 AM	**Is it Worth Chasing the Sunset**? Stefano G. Mainella, Siena College
10:00 AM	**Power Consumption for Raspberry Pi Nature Cam** Jacqueline Van Slycke, Siena College
10:15 AM	**Effect Of Solar Tracking On Power Generated By A Solar Panel** Matthew Merchant, The College at Brockport

9:00 AM – 10:30 AM: SESSION IB. ASTRONOMY AND ASTROPHYSICS (B&L 106)

SESSION CHAIR: PROF. ZACHARY ROBINSON, THE COLLEGE AT BROCKPORT

9:00 AM	**Multi-scatter Capture of Super Massive Dark Matter by the First Stars** Saiyang Zhang, Colgate University
9:15 AM	**Observable Relics of the Simple Harmonic Universe** Dr. Bart Horn and Peter Gilmartin, Manhattan College
9:30 AM	**Moon Formation** Diana Bateman and Florence LaPlaca, SUNY Fredonia
9:45 AM	**CaII Absorbers in Quasar Spectra** Matthew Withey, The College at Brockport, State University of New York
10:00 AM	**Cosmic voids in galaxy redshift surveys** Fatima Zaidouni, University of Rochester
10:15 AM	**Simulations of Precession Damping for Homogeneous Viscoelastic Rotators** Alice C. Quillen, Katelyn J. Wagner, Paul Sanchez, University of Rochester

10:30AM – 11:00 AM: SESSION II. POSTER SESSION (B&L 208)

Outflows and star-formation feedback from young stellar objects in NGC1333
Natalie Allen, Edwin Bergin, Adam Frank, Thomas Gautier, Joel Green, S. Megeath, Gary Melnick, David Neufeld, Karl Stapelfeldt, Dan Watson, University of Rochester, University of Toledo, University of Michigan, Jet Propulsion Lab, Pasadena, CA, Space Telescope Science Institute, Baltimore, MD, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, Johns Hopkins University

Generating Bessel Poincaré Beams
Brianna Holmes & Enrique Galvez, Colgate University

Quantum Entanglement in Medical Diagnosis
Faith Williams, Colgate University

Pendulum Beams: The Optical Analog of the Quantum Pendulum
Enrique J. Galvez, Kristina L. Wittler, Yingsi Qin, Fabio J. Auccapuclla, Colgate University

Impeller Mixing Simulations of Transitional Flow
Jared Malone, Josiah Kratz, Kurt M. Aikens, Houghton College

Effects of Deposition Temperature on Stacking Fault Density and Texture Transformation in Thin Silver Films
Sarah Olandt, Daniil Zhuravlev, Brandon Hoffman, Houghton College, Cornell University

Measuring Low Energy Nuclear Cross Sections Using ICF
Katleyn Cook, Emma Bruce, Sarah Hull, Mark Yuly, Stephen Padalino, Craig Sangster, Sean Regan, Houghton College, SUNY Geneseo, Laboratory for Laser Energetics

Telescope Pixel Linearity Correction
Kassidy Howard , SUNY Fredonia

Self Calibration of Isolated Star Formation
Kyle Mascara, SUNY Fredonia

Proximity Effect Correction to Improve Fabrication Using E-beam Lithography
Adina Ripin, Elliot Connors, John Nichol, University of Rochester

11:00 AM – 12:15 PM: SESSION IIIA. NUCLEAR AND PARTICLE PHYSICS (B&L 109)

SESSION CHAIR: PROF. BRANDON HOFFMAN, HOUGHTON COLLEGE

11:00 AM **Measurement Of Low-Energy Nuclear Cross Sections Using Inertial Confinement Fusion**
Katelyn Cook, Houghton College

11:15 AM **Continuing Studies On The Anomalous Decays Of Higgs Bosons**
Sarah Reese, Manhattan College, CERN, Atlas, NYU

11:30 AM **A Possible Solution To A Prevalent Electron Background In Liquid Xenon Dark Matter Detectors**
Leesa Brown, Rafael Lang, Abigail Kopec, University Of Rochester, Purdue University

11:45 AM **Supernova Neutrinos In LZ**
Yue Wang, LZ Collaboration, University of Rochester, LZ Collaboration

11:00 AM – 12:00 PM: SESSION IIIB. ASTRONOMY & ASTROPHYSICS/BIOLOGICAL PHYSICS/INSTRUMENTATION & EXPERIMENTAL TECHNIQUES/ NUCLEAR & PARTICLE PHYSICS (B&L 106)

SESSION CHAIR: PROF. GRAZIANO VERNIZZI, SIENA COLLEGE

11:00 AM	**Observing Near-Earth Asteroids With The Breyo Observatory** Tyler King, Siena College
11:15 AM	**Structural Characterization Of Cftr** Julie Lattanzio, Dr. Yuksek, Siena College
11:30 AM	**Making Bio Batteries With Winogradsky Columns** Shannon Sweet, Siena College
11:45 AM	**Student Explanations of Answers for the Electromagnetism Concept Assessment** Lauren Stevens and Michele McColgan, Siena College
12:00 PM	**Investigating Electron Decay And Violation In The Pauli Exclusion Principle** Ryan Mikulec, Siena College

12:30 PM – 2:00 PM: LUNCH & PHYSICS JEOPARDY (RUSH RHEES LIBRARY – HAWKINS-CARLSON ROOM)

2:00 PM – 2:45 PM: SESSION IVA. OTHER (B&L 109)

SESSION CHAIR: PROF. MICHELE MCCOLGAN, SIENA COLLEGE

2:00 PM	**Transition State Testing on Formic Acid** Jesus Lopez, Siena College
2:15 PM	**Combining Databases** Meghan McDonough, Siena College
2:30 PM	**A "Shiny" Monte Carlo optimization of datasets with missing entries** Thomas Becker, Siena College

1:30 PM – 2:45 PM: SESSION IVB. QUANTUM OPTICS/CONDENSED MATTER PHYSICS/ INSTRUMENTATION & EXPERIMENTAL TECHNIQUES (B&L 106)

SESSION CHAIR: PROF. CANDICE FAZAR, ROBERTS WESLEYAN COLLEGE

2:00 PM **Ito or Bayesian? An Investigation of Quantum Trajectory Models and Their Optimal Paths**
Kurt Cylke, University of Rochester

2:15 PM **Growth and Characterization of a New Family of Frustrated Ferromagnets**
David Mayrhofer, Alexandra Cote, Dalmau Reig-i-Pleissis, Gregory MacDougall, University of Rochester, University of Illinois, NSF

2:30 PM **Utilizing Neural Networks for Faster Optical Alignment**
John Piotrowski, University of Rochester, co-op at MIT Lincoln Laboratory

SESSION IA. INSTRUMENTATION & EXPERIMENTAL TECHNIQUES

Construction of a Low-Speed Closed-Return Wind Tunnel

Jonathan G. Durbin, Houghton College

A small-scale, low-speed, closed-return wind tunnel is being designed and constructed at Houghton College to provide opportunities for new research and further education. Empirical correlations were used by previous students to generate a preliminary design based on various constraints. Examples of such constraints include the size of the room, the speed within the test section, and the desired flow quality. The wind tunnel will be 4.72 meters long, have an area ratio of 4.99 between the nozzle and test section, a maximum test section speed of 44.7 m/s (100 mph), and one side of the wind tunnel will be made almost entirely out of Plexiglass. The wind tunnel will also have a maximum Reynolds number per meter of 3×10^6 (Reynolds number per foot of 9×10^6). In this presentation, specific attention is given to one of the diffusers and two of the corners. Additional details for the other components of the wind tunnel will be presented and future work discussed.

3D Laser Object Scanner

Nico Carello, Siena College

The 3D Laser Object Scanner forms a 3D image on a computer of a real object that has been scanned. Line lasers strike the object and the line is recorded by a small camera. This is done continuously as the object rotates until a 3D image is able to be plotted. Arduino IDE, Python, and Matlab are used to rotate, scan, and plot the object. Over the course of the past year, the quality of scans has increased significantly. This was done by the inclusion of a second laser. The second laser scans the object independently from the first laser to provide a larger scope of data readily available to the camera. Also, a wooden frame was built to ensure stability of the hardware and consistency of the scanned image. The eventual goal of the project is to be able to take the 3D Matlab scan to provide input for a 3D printer.

Calibrating Three Axes Accelerometer for Alzheimer's Research

Jada Hawkins-Hill, Dr. Matthew Bellis, Siena College

Smart devices and similar equipment are steadily increasing in popularity in medical fields because of their compactness, inexpensiveness, and wide range of uses. However, if these devices are not calibrated correctly, then the data collected is of no use. This experiment utilizes an Arduino ADXL335 accelerometer to record a person's acceleration in the x-, y-, and z-axes in the hopes of diagnosing early onset Alzheimer's. There is a special focus specifically on calibrating the accelerometer correctly by simulating an accelerometer calibration experiment done by a University of Iowa graduate student for his Honors thesis; with a properly calibrated system, the device will be able to report accurate accelerations for each axis and help with understanding how these accelerations can distinguish between various gaits in order to apply it to Alzheimer's research.

Is it Worth Chasing the Sunset?

Stefano G. Mainella, Siena College

It is quite evident that solar technology is a useful tool to obtain energy naturally over and over again. The problem is, however, that some geographical regions are more optimal for this implementation than others. The broad purpose of this research project is to see whether or not it is worth it to use mobile solar technology in a place like Upstate New York in the winter. I compare the usage of a stationary solar panel to a mobile solar panel. Through data analytics, I can compare the power drawn from the stationary panel to the net power of the mobile panel and the power required to have it follow the suns path.

Power Consumption for Raspberry Pi Nature Cam

Jacqueline Van Slycke, Siena College

A current collaborative project at Siena College is the design and implementation of a low cost DIY nature trail camera. The complete kit uses a Raspberry Pi with accompanying camera, temperature, humidity, lux, and pressure sensors, encased in a 3D printed waterproof case. With varying camera capabilities, several sensors, and different models of the Raspberry Pi in use, it is vital to understand power consumption values of the Raspberry Pi at different levels of operation. Using an Adafruit electric energy tester, the different standards were measured and analyzed. This data will allow for the wisest decisions to be made moving forward with distribution of the trail camera in urban locations throughout Albany.

Effect Of Solar Tracking On Power Generated By A Solar Panel

Matthew Merchant, The College at Brockport

There are many aspects of solar panels that can be improved. Currently, commercial silicon solar panels are only about 14% efficient. Research into improving this via new materials is important, but there are additional improvements that would have an immediate effect to the current systems, and those of the future. One of these is a solar tracking stage for the panels. Solar panels absorb the largest amount of solar light when they are pointed directly at the sun. For this project, I designed and 3-d printed a motorized stage to study the effect of varying the angle between a solar panel and the sun. I then wrote a LabVIEW program capable of quickly measuring the power-curve of the solar panel. With this program, I took measurements with the panel at systematically varying angles to the sun, to determine the effectiveness of solar-tracking on the power generated by the solar panel.

SESSION IB. ASTRONOMY AND ASTROPHYSICS

Multi-scatter Capture of Super Massive Dark Matter by the First Stars

Saiyang Zhang, Colgate University

Dark matter can self-annihilate and produce detectable particle flux through its capture in stars. For the case of super massive dark matter($M_\chi \geq 10^8$ GeV), it takes a large number of scattering events to slow down the dark matter particles for its to be trapped inside the stars. We compared and tested several scattering regimes for the dark matter capture. Multi-scatter capture regime provides a more general method to calculate the total capture rate. For the case of the first stars (Pop .III), they were assumed to be formed near the center of the dark matter halos, and the capture of dark matter by the first stars(Pop .III) could influence their the evolutionary phase. With the latest results on the constraints of dark-matter-baryon scatter cross-section, the total capture rate was obtained.

Observable Relics of the Simple Harmonic Universe

Dr. Bart Horn and Peter Gilmartin, Manhattan College

We analyze observational signatures that may arise from a cosmological epoch corresponding to the simple harmonic universe, which consists of positive curvature, negative cosmological constant, and one or more matter sources with an intermediate equation of state, which then tunnels and/or evolves into inflation and radiation-dominated eras. We find that the effects on the cosmic microwave background and matter power spectrum from additional matter sources are subdominant to the effects that arise due to curvature alone. Moreover, even if the curvature is too small to detect at late times, it can modify the primordial power spectrum, and may help explain the observed suppression of the CMB TT quadrupole in the Planck satellite data.

Moon Formation

Diana Bateman and Florence LaPlaca, SUNY Fredonia

One of the unanswered questions of astronomy is the formation of the moon. The Single Giant Impact hypothesis is what is currently taught in schools however there are issues with said hypothesis. Whilst there are multiple other theories, one of particular interest is the Multiple Impact hypothesis. Based upon statistics regarding simulations, the Multiple Impact hypothesis is more likely to have happened than is the Single Giant Impact hypothesis. Evidence for this alternate hypothesis supports the likelihood that the multiple impacts during Earth’s formation resulted in several planetary bodies (moonlets) merging to create what is known as the moon.

CaII Absorbers in Quasar Spectra

Matthew Withey, The College at Brockport State University of New York

CaII absorption lines in quasar spectra allows us to study astronomical objects that aren't conveniently studied by other means. The wavelengths absorbed by CaII are also at wavelengths that allow us to study the absorbers at low redshifts from the ground. Since CaII is rarely observed, a large number of quasar spectra must be observed in order to find a suitable sample of candidate systems. We present the initial results of a study of candidate CaII absorber systems initially identified by the Sloan Digital Sky Survey. Follow up spectroscopy and imaging of the fields were obtained by the Gemini 8-m telescope. Of the eleven initial candidate systems, it was determined that four of them exhibit significant absorption at the redshifted 3934 Å and 3969 Å wavelengths. One candidate system (J1431-0052) was selected for an in depth study for the presence of CaII. The data were downloaded from the Gemini database, reduced to eliminate instrumental effects, and analyzed to measure the CaII absorption. The spectra of the surrounding galaxies were observed for absorption lines at the corresponding redshift.

Cosmic voids in galaxy redshift surveys

Fatima Zaidouni, University of Rochester

The galaxy distribution in redshift surveys contains voids, regions of space that are sparsely populated by galaxies. Voids are important for cosmology, because they are dominated by dark energy, and they are astrophysically interesting because the evolution of galaxies in voids may diverge significantly from galaxies in dense clusters and filaments. Using the VoidFinder algorithm, we identify voids in large samples of galaxies in redshift surveys and mock catalogs. The algorithm sorts galaxies into field galaxies or wall galaxies and detects empty cells in the distribution of wall galaxies. Unique voids are formed by growing and merging spheres in these empty cells. We visualize the resulting voids to inspect their distribution and gain a better understanding of their shapes. We have developed void selection criteria to minimize the "edge effects" in galaxy surveys, and are working to improve the efficiency of VoidFinder by parallelizing the algorithm. We are currently comparing the performance of VoidFinder against ZOBOV, a different void-finding algorithm, to characterize their systematics and relative efficiencies. This research contributes to the Dark Energy Spectroscopic Instrument (DESI) group's research on the baryon acoustic oscillation (BAO) signal.

Simulations of Precession Damping for Homogeneous Viscoelastic Rotators

Alice C. Quillen, Katelyn J. Wagner, Paul Sanchez, University of Rochester

Using a damped mass-spring model, we simulate wobble of spinning homogeneous viscoelastic ellipsoids undergoing non-principal axis rotation. Energy damping rates are measured for oblate and prolate bodies with different spin rates, spin states, viscoelastic relaxation time-scales, axis ratios, and strengths. Analytical models using a quality factor by Breiter et al. and for the Maxwell rheology by Frouard & Efroimsky match our numerical measurements of the energy dissipation rate after we modify their predictions for the numerically simulated Kelvin-Voigt rheology.

SESSION II. POSTER SESSION

Outflows and star-formation feedback from young stellar objects in NGC1333

Natalie Allen, Edwin Bergin, Adam Frank, Thomas Gautier, Joel Green,
S. Megeath, Gary Melnick, David Neufeld, Karl Stapelfeldt, Dan Watson, University of Rochester, University of Toledo, University of Michigan, Jet Propulsion Lab, Pasadena, CA, Space Telescope Science Institute, Baltimore, MD, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, Johns Hopkins University

NGC1333 is a nearby star-forming region in Perseus which is particularly rich in Class 0/I protostars and associated outflows. We have mapped the entire NGC 1333 complex (~ 400 arcmin^2) in near- and mid- infrared spectral lines which trace the supersonic interaction of these outflows with their surroundings. Here we present new Hubble Space Telescope Wide Field Camera 3 spectral images in two [Fe II] lines and H I Pa beta, and earlier Spitzer Space Telescope Infrared Spectrograph images of many more molecular and atomic emission lines. We use these data along with detailed shock models to make accurate rate measurements of the mass, momentum, and kinetic energy deposited into the surrounding cloud by the protostellar outflows. We also determine accurately the extinction toward the shocks, which enables us to determine the location of the energy/momentum deposition in quasi-3D.

Generating Bessel Poincaré Beams

Brianna Holmes & Enrique Galvez, Colgate University

Working with Professor Enrique Galvez for my senior research, we studied complex structures on nondiffracting beams with orbital angular momentum. In particular, we investigated the generation of Bessel Poincaré beams. Bessel beams, being a nondiffracting beam, do not change their shape or size when they propagate. Poincaré beams, named for the Poincaré sphere, are beams with spatially variable polarization, meaning they contain every state of polarization. When combined, the Bessel Poincaré beam can theoretically be used to transmit a high volume of information across long distances.

In order to create the Bessel Poincaré beams, we used two Spatial Light Modulators that each encoded a Bessel function with a controllable topological charge onto the vertical and horizontal components of a light beam and allowed us to create high-order lemon and star patterns. We then sent the encoded light beam through a polarimetry setup. Placing a camera after the polarimetry setup, we imaged the intensity of six polarization states, thus allowing us to collect the Stokes parameters and analyze every part of the beam's radius. From this analysis, we were able to compare experimental data to theoretical predictions and found that our results matched our expectations excellently.

Quantum Entanglement in Medical Diagnosis

Faith Williams, Colgate University

When the light goes through brain tissue it scatters due to interactions between the water and hemoglobin. This research investigated whether different types of brain tissue would produce specific scattering patterns by using quantum information to characterize the passage of entangled photons through brain tissue. The intentions of the research were to study the capabilities of entangled photons to distinguish healthy and diseased tissue by analyzing the change in the entanglement of the photon pair after one photon traverses a sample. Quantum state tomography can be used to measure the level of entanglement between entangled photon pairs. A quantum state tomography is performed by taking projective measurements of photon pairs passing through different polarization states to reconstruct the quantum state of the photons. Thus, this research sought to discover the potential of quantum entanglement as a new imaging technique for disease detection in brain tissue.

Pendulum Beams: The Optical Analog of the Quantum Pendulum

Enrique J. Galvez, Kristina L. Wittler, Yingsi Qin, Fabio J. Auccapuclla, Colgate University

Keywords: Non-diffracting beams, Pendulum beams, Mathieu beams, Quantum pendulum

Impeller Mixing Simulations of Transitional Flow

Jared Malone, Josiah Kratz, Kurt M. Aikens, Houghton College

Impellers have a wide variety of industrial applications and are utilized in many industries. They are an integral part of the mixing process. The potential for operating inefficiencies causing large financial losses motivate the field to develop processes with which to accurately model the mixing process. Computational fluid dynamics (CFD) is a powerful tool for analyzing mixing scenarios. Multiple methodologies were used to simulate impeller mixing at different operating conditions. Results were compared to experimental data provided by SPX Flow to assess the validity of these methodologies. It is hoped that these comparisons will lead to a proper methodology for simulating impellers operating in the transitional flow regime, which has notoriously been a challenging task. Presently, the mixing problem is being evaluated in a baffled tank with an A200 impeller at various Reynolds numbers. Power number and mixing time predictions are calculated and compared with available data and correlations.

Effects of Deposition Temperature on Stacking Fault Density and Texture Transformation in Thin Silver Films

Sarah Olandt, Daniil Zhuravlev, Brandon Hoffman, Houghton College, Cornell University

X-Ray Diffraction analysis was used to measure stacking fault density and texture transformation in silver films produced via electron-beam evaporation. Films were deposited onto heated substrate to obtain samples with different deposition temperatures. Texture and fault density of samples was measured in as-deposited states to reveal fewer faults in films deposited at higher temperatures. Analysis of measurements taken after intervals of annealing revealed less (111) to (100) texture transformation in films deposited at higher temperatures. Also, periodic scans during annealing show a decreasing stacking fault density.

Measuring Low Energy Nuclear Cross Sections Using ICF

Katleyn Cook, Emma Bruce, Sarah Hull, Mark Yuly, Stephen Padalino, Craig Sangster, Sean Regan, Houghton College, SUNY Geneseo, Laboratory for Laser Energetics

Inertial confinement fusion is a tool that can be used for fundamental nuclear science measurements. In the method under consideration, nuclear reaction products in the expanding atomic gas following the target implosion will be collected and trapped using a turbomolecular pump. The beta-decay of reaction products with half-lives ranging between 20 ms and 10 s will be measured in-situ using a phoswich detector system milliseconds after the implosion. Several previously unmeasured low-energy deuterium and tritium radiative capture and stripping cross sections could be measured using this technique. To study the feasibility, several small scale experiments are being carried out at Houghton College and SUNY Geneseo to simulate the rapid release of gas by the ICF target, its subsequent capture and decay counting.

Telescope Pixel Linearity Correction

Kassidy Howard, SUNY Fredonia

Whether it be our own moon or distant stars thousands of light years away, being able to capture an image of any celestial body is a task that requires extreme precision. However, this precision can be lost without careful adjustments. When taking images of celestial bodies, there is a direct correlation between the amount of time the camera collects light and the signal recorded by the camera. This relationship is supposed to be linear but as the pixels approach their saturation levels, the relationship begins to level off and display a non-linear response. The goal of this research project is to find where this relationship becomes non-linear and then establish a pixel-by-pixel linearity correction that can be applied to all science images.

Self Calibration of Isolated Star Formation

Kyle Mascara, SUNY Fredonia

Radio interferometry can be used to answer a plethora of astronomical questions. One question is why stars form single systems or fragment into binary and triple systems. Here we use the ALMA array to build a survey of isolated star formation which hasn't been done previously because the ALMA array is the first array to have a resolution good enough. One way to extrapolate the information collected from telescope arrays is to create images and "lean" them. The cleaning process takes the images created from the data collected by a telescope array and filters out the general noise created by the interferometry process. The images created by this process can yield information on binary systems and the process of star formation. One particular cleaning process called self-calibration can sometimes greatly improve the quality of an image. We are focusing on self-calibration to try and create the best possible images. In this presentation we will showcase the image improvements possible through self-calibration and present preliminary results on the multiplicity of protostars in forming in truly isolated environments.

Proximity Effect Correction to Improve Fabrication Using E-beam Lithography

Adina Ripin, Elliot Connors, John Nichol, University of Rochester

I worked on modeling the proximity effect in materials developing a program that would adjust the dose the SEM uses when writing a pattern based on the predicted proximity effects.

SESSION IIIA. NUCLEAR AND PARTICLE PHYSICS

Measurement Of Low-Energy Nuclear Cross Sections Using Inertial Confinement Fusion

Katelyn Cook, Houghton College

Inertial confinement fusion is a tool that can be used for fundamental nuclear science measurements. In the method under consideration, nuclear reaction products in the expanding atomic gas following the target implosion will be collected and trapped using a turbomolecular pump. The beta-decay of reaction products with half-lives ranging between 20 ms and 10 s will be measured in-situ using a phoswich detector system milliseconds after the implosion. Several previously unmeasured low-energy deuterium and tritium radiative capture and stripping cross sections could be measured using this technique. To study the feasibility, several small scale experiments are being carried out at Houghton College and SUNY Geneseo to simulate the rapid release of gas by the ICF target, its subsequent capture and decay counting.

Continuing Studies On The Anomalous Decays Of Higgs Bosons

Sarah Reese, Manhattan College, CERN, Atlas, NYU

With the discovery of the Higgs Boson in the rearview mirror, particle physicists are working to understand its unique characteristics. One particular property we wish to observe in the Higgs sector is CP Violation. It is possible to study CP violating Higgs processes through Effective Field Theories. Simulations made using MonteCarlo generators lay the groundwork for the detection of new particles and new physics. This proposal outlines our continuing studies of simulations of anomalous Higgs decay processes. Specifically, we want to study the kinematic distributions of particles in the Higgs decays. Currently we are examining the ggF, VBF, VH modes of Higgs production and its decay into a four lepton final state.

A Possible Solution To A Prevalent Electron Background In Liquid Xenon Dark Matter Detectors

Leesa Brown, Rafael Lang, Abigail Kopec, University Of Rochester, Purdue University

Electron trains are a major background in liquid xenon dark matter experiments. These are multiple S2 signals that occur over a millisecond time scale and are not correlated with S1s. As normally the S1 and S2 signals from the same event are separated by microseconds, the long S2 signals obscure potentially interesting events. My research as a REU student at Purdue contributed to the goal of mitigating the single electron background through a possible hardware solution. The barrier between the liquid and gas interface has a potential of 0.34 eV, so when an electron that was unable to overcome the barrier scatters with a photon of energy greater than the barrier, the electron should be able to overcome the potential barrier. This was tested with the ASTERiX detector, a small R&D liquid xenon dark matter detector located at Purdue.

Supernova Neutrinos In LZ

Yue Wang, LZ Collaboration, University of Rochester, LZ Collaboration

The LUX-ZEPLIN (LZ) collaboration focuses on the direct detection of dark matter. LZ detector is currently being assembled in South Dakota and will start collecting data in 2020. Besides potential dark matter particles, the detector is also sensitive to neutrinos associated with a supernova explosion. In order to understand the supernova neutrino detection in LZ better, we have to simulate the behavior of the LZ detector to such neutrinos. In this project, the reliability of the random supernova neutrino energy generator was tested. A modified bin test used to verify the reliability of the neutrino simulator will be described in my talk.

SESSION IIIB. ASTRONOMY & ASTROPHYSICS/BIOLOGICAL PHYSICS/ EDUCATIONAL PHYSICS/NUCLEAR AND PARTICLE PHYSICS

Observing Near-Earth Asteroids With The Breyo Observatory

Tyler King, Siena College

Observing Near Earth Asteroids is important because if we can detect and track them, then we can watch out for potential collisions with Earth. Observations can also tell us about their composition and rotation periods. Current surveys of Near Earth Asteroids are discovering and confirming NEA's, but there are many asteroids that still need to be confirmed and characterized. I am currently working on an effective method of data reduction for CCD images taken with the Breyo Observatory. The observatory features a brand new 0.7 meter telescope from the Sherman Fairchild Foundation named after John J. Breyo and his wife Marilyn Breyo. The Breyo Observatory is still new so one of the challenges is to figure out how best to operate it. Some observations of asteroids have already been taken with different filters, red, green, and blue. The goals for this project are to work on obtaining a light curve and aperture photometry of several near earth asteroids.

Structural Characterization of CFTR

Julie Lattanzio, Dr. Yuksek, Siena College

The cystic fibrosis transmembrane regulator (CFTR) is a member of the adenosine triphosphate (ATP) binding cassette (ABC) superfamily, the largest and most diverse transporter family providing the translocation of a variety of substrates across the cell membrane by using ATP hydrolysis as the source of free energy. CFTR is the only ABC transporter that functions as an ion channel (chloride channel) and its loss of function results in the genetic disease cystic fibrosis (CF). The CFTR channel is composed of two transmembrane domains (TMDs) that form the channel pore, two cytoplasmic nucleotide-binding domains (NBDs) that control the opening and closing of the channel, and a unique regulatory domain (RD). In this work, we have analyzed the recorded fluorescence signals representing directly different conformations. We are calculating the FRET efficiencies within the cell to correlate the results of those optical recordings with the gating mechanism of CFTR.

Making Bio Batteries With Winogradsky Columns
Shannon Sweet, Siena College

The goal of this project is to find which type of proton exchange membrane (PEM) enables a bio batteries made from a Winogradsky column to generate the highest voltage. Twenty batteries were made with four batteries for each PEM type, no PEM, coffee filter, paper, foam, and felt. The membranes were placed in the middle of the Winogradsky column with an aluminum foil anode at the bottom, connected to a graphite cathode. Voltage of the batteries will be measured after a couple of months pass giving the Winogradsky column time to establish bacterial colonies.

Student Explanations of Answers for the Electromagnetism Concept Assessment
Lauren Stevens and Michele McColgan, Siena College

Little is known about how students think about physics concepts while answering multiple choice questions on physics assessments. For my presentation, I analyzed student explanations of answer choices for the Electromagnetism Concept Assessment administered at Siena College. Students were asked to provide explanations of their answer choices during a pretest at the beginning of the semester and a posttest at the end of the semester. Questions were grouped by concept and difficulty, and common themes were identified in student explanations. Explanations of answer choices were analyzed to see if the student understood the ideas and necessary concepts behind each question to answer it correctly. The correlation between correct answer choice and explanation for problems with varying difficulty will be presented. This information can be used by teachers and professors to enhance the way they teach physics topics to students.

Investigating Electron Decay And Violation In The Pauli Exclusion Principle
Ryan Mikulec, Siena College

Rare events in particle physics have been proposed. The two that will be discussed are electron decay, and a violation in the Pauli Exclusion Principle. These events require data from highly sensitive detectors, such as those being used to investigate dark matter. An example of this is a High purity germanium P-type point contact detector. We can analyze electron decay and Pauli Exclusion Principle by obtaining an upper limit on the lifetime of the events.

SESSION IVA. OTHER

Transition State Testing on Formic Acid
Jesus Lopez, Siena College

Our goal is to model Tandem Mass Spectrometry (TMS) computationally using a combination of molecular dynamics simulations, RRKM theory, and kinetic Monte Carlo techniques. The technique has been published in collaboration with research groups in Spain; however, the current implementation is difficult to modify and inconsistent. Therefore, this summer we have re-developed, from the ground up, the code that will automatically find transition states (TSs) as a first step towards this goal. Starting from just the cartesian coordinates of a molecule, the code automatically locates and stores the TS and minima for a the chosen chemical system. We tested our code using Formic Acid (FA). All relevant information is stored in a Sqlite3 database making it easily portable and retrievable.

Combining Databases
Meghan McDonough, Siena College

The National Ecological Observatory Network (NEON) is a continental-scale ecological observation network which collects open environmental data from field sites across the United States Unfortunately, NEON sites are primarily located in pristine or remote areas, so NEON lacks coverage of more urbanized or suburban areas. The Ecological Research as Education Network (EREN) is a network of faculty at primarily Undergraduate Institutions (PUIs) that have several collaborative research projects EREN data is also collected at a continental-scale, but most of the college campuses are located in suburban or rural sites. EREN researchers are interested in broadening the utility of these data by combining Permanent Forest Plot (PFPP) data (collected at EREN sites) with Woody and Herbaceous data (collected at NEON sites). Once these datasets are combined, relationships between vegetation data and other environmental variables (e.g., soils, elevation) collected across the sites can be explored.

A "Shiny" Monte Carlo optimization of datasets with missing entries

Thomas Becker, Siena College

In this work we developed a fast, efficient, and robust method to remove missing data from large datasets. Historically, one of the simplest solutions is to just delete all respondents that have any missing entry (listwise deletion method). In general, this is not the most desirable solution because it often depletes the dataset so seriously to cause imprecise statistics. A more advanced technique would be to find the optimal number of respondents while removing a group of variables from the dataset, in such a way that the number of remaining entries is maximized. Determining which columns (i.e. variables) and rows (respondents) to delete from the datasets is a NP-complete problem. Monte Carlo methods are most effective to address this kind of problems. Therefore, we developed a Monte Carlo algorithm for randomly deleting variables and apply listwise deletion, while trying to maximize the number of remaining entries. In addition, we improved the Monte Carlo method by including the possibility of constraining a subset of variables that cannot be absolutely deleted during the optimization. The code has been written in R language, and is implemented with "Shiny", which is a server-based R package that allows the creation of a clean and easy-to-use graphical user interface that runs the code in the background constantly, while letting the user deal only with the inputs and the graphical outputs.

SESSION IVB. INSTRUMENTATION/ EXPERIMENTAL TECHNIQUES

Ito or Bayesian? An Investigation of Quantum Trajectory Models and Their Optimal Paths

Kurt Cylke, University of Rochester

Unlike strong quantum measurements, a sequence of weak measurements will gradually collapse the qubit state; tracking the stochastic state dynamics yields quantum trajectories. Both a Bayesian probability approach and a stochastic master equation approach have been used to model this measurement backaction and collapse. Using a stochastic path integral and an action-extremization principle, we can reduce the stochastic dynamics of the system to that of a Hamiltonian which describes the most likely quantum paths. We consider the dynamics when measurements are made made along the Z axis of the Bloch sphere and when simultaneous Z and X measurements are made. The Hamiltonians for each measurement are very similar but contain subtle and important differences. Preliminary results indicate that topological differences in the phase spaces for the two Hamiltonians create conditions under which there are discrepancies between the theoretical most likely collapse paths for the two models. Further work to better understand these discrepancies is in progress.

Growth and Characterization of a New Family of Frustrated Ferromagnets

David Mayrhofer, Alexandra Cote, Dalmau Reig-i-Pleissis, Gregory MacDougall, University of Rochester, University of Illinois, NSF

Frustrated magnetic system form a class of matter that allow for examination of various unique properties not commonly found in other materials. This is due to the large degeneracy of the ground state which renders the exchange interaction, the term that usually governs magnetic materials at low temperatures, unable to order the system. This leads to terms in the Hamiltonian that are normally neglected to have an observable effect on the system. Recently, a new family of frustrated ferromagnets that take the form MgRe2Se4 has been identified, where Re stands for rare Earth metal and includes holmium, thulium, erbium, and ytterbium. Techniques for the growth of MgRe2Se4 crystals are discussed, as well as the relationship between magnetization measurements and neutron scattering for these new frustrated ferromagnets.

Utilizing Neural Networks for Faster Optical Alignment

John Piotrowski, University of Rochester, co-op at MIT Lincoln Laboratory

The alignment of complex optical systems is a tedious process that often has few clear correlations between available degrees-of-freedom and the measured system wavefront error. Using recent advancements in machine learning, we are able to train a neural network with thousands of Monte-Carlo runs of wavefront data from a randomly misaligned optical system modeled in commercial lens design software. In a simulation of a catadioptric telescope, the neural network's misalignment predictions from a single wavefront allow us to recover a majority of the system performance lost due to initial misalignments. The methodology implemented, results of the simulation, and the direction of this study will be reported.

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Genesee River
River Campus
Genesee Valley Park
Mount Hope Cemetery
Prince Athletic Complex
Goergen Athletic Center
Rush Rhees Library
Bausch & Lomb
Wilson Commons
Douglass Commons
Eastman Quadrangle
Hajim Science & Engineering Quadrangle
Wilson Quadrangle
Library Lot
Trustee Lot
Medical Center Annex
Central Utilities Plant