Rochester, April 1 2017

Dear Participants:

Welcome to the 36th 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/2017/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:

http://www.pas.rochester.edu/special/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

NAME	TIME	ROOM
Jamie Bedard	2:00 PM	B&L 106
Tom Brick	10:15 AM	B&L 208
Joseph Caldara III	2:15 PM	B&L 106
Elisha Cheeran	11:15 AM	B&L 106
Frank Chietro	9:45 AM	B&L 106
Katelyn Cook	10:15 AM	B&L 208
AnnaMaria Dear	10:00 AM	B&L 109
Dan Eager	10:15 AM	B&L 208
Mattison Flakus	10:15 AM	B&L 208
Samuel Fordin	10:15 AM	B&L 208
Michael Ganger	1:15 PM	B&L 106
Alyx Gleason	10:00 AM	B&L 106
Ian Greer	2:00 PM	B&L 109
Simon Gurvets	1:30 PM	B&L 106
Jonathan Jaramillo	9:00 AM	B&L 106
Alexis Klimasewski	11:45 AM	B&L 109
Heidi Kroening	9:30 AM	B&L 106
Andrea Kueter-Young	9:30 AM	B&L 109
Michelle Lieu	11:45 AM	B&L 106
Sara Mahar	1:15 PM	B&L 109
Miranda Marnes	11:00 AM	B&L 106
Calvin Nguyen	9:45 AM	B&L 109
Jordon Penor	1:30 PM	B&L 109
Heather Phillips	10:15 AM	B&L 208
John Piotrowski	2:30 PM	B&L 109
Zachary Rahilly	11:30 AM	B&L 106
Andrew Redman	9:15 AM	B&L 106
Ryan Rubenzahl	11:00 AM	B&L 109
Alexander Sidou	1:45 PM	B&L 109
Kenneth Tousignant	9:00 AM	B&L 109
Christopher Wahl	11:30 AM	B&L 109
Alexander Warn	1:45 PM	B&L 106
Kelly Whalen	9:15 AM	B&L 109
Paul Wrona	2:15 PM	B&L 109
Cameron Ziegler	11:15 AM	B&L 109

XXXVI – ROCHESTER SYMPOSUM FOR PHYSICS (ASTRONOMY AND OPTICS) STUDENTS
SPS ZONE 2 REGIONAL MEETING

PROGRAM

8:15 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 – 10:15 AM: SESSION IA. ASTRONOMY & ASTROPHYSICS (B&L 109)

SESSION CHAIR: PROF. CHAD SCHOOLS, UNITED STATES MILITARY ACADEMY

9:00 Computational Modeling of Dust Grains and Biomolecules in Star Forming Regions
Kenneth Tousignant and Dr. George Hassel, Siena College

9:15 Identification and Properties of Galaxies in the Filaments Around the Virgo Cluster
Kelly Whalen and Dr. Rose Finn, Siena College

9:30 DESI and Gravitational Lensing
Andrea Kueter-Young, Siena College

9:45 West Point Observatory
Calvin Nguyen and Michael Lee, United States Military Academy

10:00 Using Differential Photometry to Determine Rotational Period of Asteroids
AnnaMaria Dear, United States Military Academy

9:00 AM – 10:15 AM: SESSION IB. INSTRUMENTATION/EXPERIMENTAL TECHNIQUES (B&L 106)

SESSION CHAIR: PROF. MARK YULY, HOUGHTON COLLEGE

9:00 Design and Construction of the Houghton College Low-Speed Wind Tunnel
Jonathan Jaramillo, Houghton College

9:15 Development and Integration of a Low Cost, High Voltage Power Supply into a Thin Film Deposition System
Andrew Redman and Brandon Hoffman, Houghton College

9:30 Development of the Optical Feedback System of an Atomic Force Microscope
Heidi Kroening, Houghton College

9:45 Senior Capstone Project
Frank Chietro and Dr. Finn, Siena College

10:00 Constructing a Gravity Battery Using a Microwave Motor
Alyx Gleason, Siena College

10:15AM – 11:00 AM: SESSION II. POSTER SESSION (LOBBY AND B&L 208)

Atmospheric Pressure Plasma Jet: Shielding Gas Effects on DNA Damage
Mattison Flakus, James Kapaldo, and Sylwia Ptasinska, University of Rochester and University of Notre Dame

The Effect of Stacking Fault Energy on Texture Transformation in Thin Metal Films
Heather Phillips, Yan Tang, and Brandon Hoffman, Houghton College

Characterization of Spin-Coated Perovskite Thin Films
Samuel Fordin, Professor Yongli Gao, Ben Ecker and Congcong Wang, University of Rochester

Measurement of the 6He Decay Produced by the 9Be(n,alpha)6He Reaction
Katelyn Cook, Micah Coats, Mark Yuly, Stephen Padalino, Craig Sangster and Sean Regan, Houghton College, SUNY Geneseo, Laboratory for Laser Energetics

Validation of the gFR Computational Fluid Dynamics Methodology
Dan Eager, Houghton College

Particle Motion in kappa-Poincare Symmetry
Tom Brick, CUNY - City College of New York

11:00 AM – 12:00 PM: SESSION IIIA. ASTRONOMY AND ASTROPHYSICS (B&L 109)

SESSION CHAIR: PROF. CANDICE FAZAR, ROBERTS WESLEYAN COLLEGE

11:00 Analyzing TeV Gamma-Ray Binary Candidates with the HAWC Observatory
Ryan Rubenzahl, University of Rochester

11:15 Refining the Supernova Event Significance Calculation in IceCube
Cameron Ziegler, University of Rochester and SUNY Geneseo

11:30 The Search For A Standard Candle Effect in the Sloan Digital Sky Survey Quasar Database
Christopher Wahl, SUNY Brockport

11:45 Ionospheric Scintillation and Radio Wave Propagation
Alexis Klimasewski, University of Rochester and Sandia National Labs

11:00 AM – 12:00 PM: SESSION IIIB. INSTRUMENTATION/EXPERIMENTAL TECHNIQUES (B&L 106)

SESSION CHAIR: PROF. MICHELE MCCOLGAN, SIENA COLLEGE

11:00 Solar Tracker Using an Arduino
Miranda Marnes, Siena College

11:15 Computational and Experimental Analysis of the R.I.T e-NABLE Arm
Elisha Cheeran, Dr. Graziano Vernizzi, and Dr. Gregory Byrnes, Siena College

11:30 VIPER Telescope
Zachary Rahilly and George Hassel, Siena College

11:45 SEM Analysis of Commercial Materials
Michelle Lieu, Dr. G Vernizzi, and Dr. K Kolonko, Siena College

12:00 PM – 1:00 PM: LUNCH (RUSH RHEES LIBRARY – HAWKINS-CARLSON ROOM)

1:15 PM – 2:45 PM: SESSION IVA. OTHER (B&L 109)

SESSION CHAIR: PROF. ERIC MONIER, SUNY BROCKPORT

1:15 Analyzing Homelessness Data Using Python
Sara Mahar and Matthew Bellis, Siena College

1:30 Bike Generator
Jordon Penor, Siena College

1:45 Graphene Growth in the Presence of Background Gases
Alexander Sidou and Mayuka Sasaki, SUNY Brockport

2:00 Generating High Power Femtoseconds Optical Pulses Using a Yb:KGW Modelocked Laser
CDT Ian Greer, United States Military Academy

2:15 Studying the Effects of Morphology on Conjugated Polymer Photophysics
Paul Wrona, University of Rochester

2:30 Characterization of the NEOCam Infrared Detector Arrays
John Piotrowski, University of Rochester

1:15 PM – 2:30 PM: SESSION IVB. NUCLEAR AND PARTICLE PHYSICS & INSTRUMENTATION/EXPERIMENTAL TECHNIQUES (B&L 106)

SESSION CHAIR: PROF. BRANDON HOFFMAN, HOUGHTON COLLEGE

1:15 A Parity Violation Experiment for Undergraduate Laboratories
Michael Ganger, Houghton College

1:30 Brane Brick Models and 2d (0,2) triality
Simon Gurvets, City College of New York

1:45 E-NABLE Pedometer
Alexander Warn, Siena College

2:00 Gravity Battery: Energy Storage Using Gravitational Potential Energy And A Bike Dynamo
Jamie Bedard and Matt Bellis, Siena College

2:15 Charging a Battery with a Solar Panel
Joseph Caldara III, Siena College

SESSION IA. ASTRONOMY & ASTROPHYSICS

Computational Modeling of Dust Grains and Biomolecules in Star Forming Regions

Kenneth Tousignant and Dr. George Hassel, Siena College

Astrochemistry is a broad field that encompasses many different parts of scientific inquiry, such as experimentation in laboratories that can create conditions similar to those of star-forming regions, observations of these regions, and experimental and computational modeling of these regions during and after their formation. Exploring the chemistry of interstellar regions, and in particular the reactions that occur in the ices of interstellar grains, allows us to simulate chemical composition in the molecular clouds as they evolve over time. The surface binding energy for desorption from grain surfaces is a vital parameter in the computational codes that we utilize, but they often use estimates in lieu of exact measurements. In recent years, Dr. Gianfranco Vidali has revisited careful measurement of these values with his research team at Syracuse University's Astrophysics and Surface Science Research Laboratory.

Our goal is simple: We have adopted the available Syracuse results of binding energy to incorporate into existing codes to compare with previous models, in order to examine the effect these new measurements have on chemical model results. Another derivative goal is to learn more about the possible formation of amino acid precursors in these regions of space, where finding these building blocks of life could be a breakthrough in terms of understanding biomolecules that originate in star-forming areas.

Identification and Properties of Galaxies in the Filaments Around the Virgo Cluster

Kelly Whalen and Dr. Rose Finn, Siena College

Galaxies can exist in a myriad of environments throughout the universe. One major difference between these environments is the density of the galactic population. Observations have shown that galaxies in higher density environments, such as clusters and groups, tend to have lower star formation rates than galaxies that exist by themselves in the field. Large galaxy clusters, such as the Virgo cluster, have filaments of galaxies feeding the cluster. Although they are less dense than the cluster, it is possible that these filaments are dense enough to impact the galaxies that pass through them as they fall into the cluster. Using galaxies in previously identified filaments surrounding Virgo, I compare these filament galaxies to their counterparts in the cluster and field. Specifically, we compare star-formation rates as determined from Galaxy Evolution Explorer (GALEX) near ultraviolet and WISE infrared data, atomic gas measurements, and existing and newly obtained CO measurements, all as a function of stellar mass.

DESI and Gravitational Lensing
Andrea Kueter-Young, Siena College

One of the most powerful ways of discovering and studying faint, distant galaxies is to use a foreground galaxy---and its surrounding dark matter halo---as a natural "gravitational lens," which magnifies the light of the more distant background galaxy. Starting around 2019, the Dark Energy Spectroscopic Instrument (DESI) will begin a 5-year survey to obtain spectra of more than 20 million galaxies. We have developed a suite of spectral simulations to investigate the efficiency with which DESI observations will serendipitously discover gravitationally lensed background galaxies. Our work will ultimately lead to a better understanding of galaxy formation as well as help place constraints on cosmological parameters.

West Point Observatory
Calvin Nguyen and Michael Lee, United States Military Academy

The United States Military Academy Observatory is a relatively new facility that was installed on campus two years ago. Since then, the facility has had three separate research groups familiarize with and utilize the equipment in order to further the Academy's astronomy program. Last semester, successful objectives included imaging of the moon, Saturn, and the Orion Nebula. This semester, Cadets Michael Lee and Calvin Nguyen are working with the observatory's 16-inch telescope and are practicing astrophotography with the purpose of capturing images of deep space objects. The learning curve has been steep due to the difficulty of operating the equipment; consequently, we have set out to produce a User's Manual as work is conducted in the observatory for the facility's equipment. This will help to outline the steps to the research conducted, and it will also mitigate difficulties for future research groups in familiarizing themselves with the equipment. The primary goal of this semester is to image variable stars and galaxies. The desired endstate is an established portfolio of VY Canis Majoris at various intervals to display the different states of the pulsating star and demonstrate proficiency with the equipment of the West Point Observatory.

Using Differential Photometry to Determine Rotational Period of Asteroids

AnnaMaria Dear, United States Military Academy

I am currently a freshman conducting an independent research project in astronomy at the Unites States Military Academy at West Point. Due to the new condition of our observatory, which now houses a 16” Meade LX200-ACF telescope, much of my year has been devoted to learning and documenting how to operate the observatory. I have experience with astrophotography and image processing, which I have also practiced in the new observatory. This semester I intend to image an asteroid, 1999 Normanrockwell, find its rotational period through differential photometry, and submit to the Minor Planet Bulletin. I have also selected an asteroid with a short known rotational period, 3606 Pholja, to measure to determine the accuracy of my results with the new observatory. My goal is to translate my experience from astronomy research in high school to the development of an effective research program.

SESSION IB. INSTRUMENTATION/EXPERIMENTAL TECHNIQUES

Design and Construction of the Houghton College Low-Speed Wind Tunnel

Jonathan Jaramillo, Houghton College

Despite advances in computational aerodynamics, wind tunnels are and will continue to be a cornerstone in the design process for a wide range of vehicles. This mostly stems from the difficulties of accurately and efficiently predicting turbulent flowfields computationally. To expand in-house aerodynamics capabilities, a general-purpose low-speed wind tunnel is being designed and built in the Houghton College Physics Department. This wind tunnel is designed to reach test section speeds of up to 100 miles per hour. To aid in the initial design, semi-empirical formulas are used to estimate aerodynamic efficiencies and the required fan-blower power as a function of various design choices. Tunnel geometry is selected to optimize test section air flow quality, test section size, and diffuser angle (to avoid boundary layer separation), while the overall tunnel size is constrained to fit in the allotted laboratory space. The proposed closed-circuit wind tunnel is vertically oriented to reduce footprint, and is 15.5 feet long by 5.5 feet tall by 2.5 feet wide. The overall design is presented and current design and construction progress is highlighted. Additionally, future research studies that could utilize the wind tunnel are discussed.

Development and Integration of a Low Cost, High Voltage Power Supply into a Thin Film Deposition System

Andrew Redman and Brandon Hoffman, Houghton College

An apparatus was constructed to systematically deposit a Silver thin film using thermionic emission. Two 2 kV transformers designed for use in a microwave oven were used to create a safety interlocked, low cost, high voltage power supply capable of supplying 0.1 A peak current at 3 kV. Tests are being conducted to determine the consistency of the power supply and create a repeatable process for depositing a thin film."

Development of the Optical Feedback System of an Atomic Force Microscope

Heidi Kroening, Houghton College

A low-cost atomic force microscope (AFM) is under development at Houghton College. Once operating, the AFM will be used to characterize the surface topography of thin metal films. The AFM will be equipped with a modified “Johnny Walker” sample mount to allow for a controlled approach of the sample to the cantilever tip. An optical laser system will be used to image the sample. The beam footprint of a laser reflected off a cantilever oscillating at its resonant frequency will be measured on a Conex PSD9 position sensing detector. A feedback loop written in LabVIEW will control the distance between the cantilever tip and the sample. In order to minimize vibrations, an eddy current and spring dampening system will be implemented.

Senior Capstone Project
Frank Chietro and Dr. Finn, Siena College

Siena College is planning to build a 0.7 meter diameter telescope on campus to support student research and provide hands on learning opportunities for the 40 % of Siena students who take introductory astronomy. The currently favored site for the telescope is on the roof of the existing science building, but vibrations from electronic equipment, wind, and other sources could undermine the performance of the telescope. To assess, we implemented a vibrational data acquisition device by linking an accelerometer to an Arduino in order to initialize data collection at a possible observatory site. We used Arduino C to develop a code that not only connected the Arduino apparatus to the institutions wireless router but also sent the acquired data to a private channel for further investigation. The data was then analyzed to determine the vibration source and assess its magnitude. If the telescope location needed to be altered based on the data, the institution would be notified.

Constructing a Gravity Battery Using a Microwave Motor
Alyx Gleason, Siena College

The Gravity Light is a device that allows those who do not have access to electricity to have a safe light source. This can be useful to families in developing countries that currently need to use kerosene to light their homes at night. This can be very dangerous to children, as many of them have been burned, or affected by the fumes from the kerosene. One of the inventors of the Gravity Light was inspired by a trip to Kenya, where he saw children using kerosene lamps to do their homework at night.

The goal of my project is to build a similar device, our "gravity battery", to generate electricity. A mass will be lifted to a fixed height to store potential energy, and then that mass will drop, converting the potential energy to kinetic energy. As the weight falls, we use a series of wheels and pulleys to drive a small motor, producing enough current to power a low-wattage LED. This is a great way to have clean energy that is created from gravity. It can run for as long as you want at no cost, as long as you continue to raise and lower the weight. The current status of the prototype and other aspect of renewable power will be discussed.

SESSION II. POSTER SESSION

Atmospheric Pressure Plasma Jet: Shielding Gas Effects on DNA Damage

Mattison Flakus, James Kapaldo, and Sylwia Ptasinska, University of Rochester and University of Notre Dame

The application of atmospheric pressure plasmas (APPs) to medicine has been of interest recently because of their potential to be an effective form of cancer therapy. These APPs have been shown to induce DNA damage with practicality for the medical discipline due to operation in ambient conditions. The mechanism by which plasma damages DNA remains unknown, but previous research indicates that reactive oxygen (ROS) and nitrogen (RNS) species within the plasma are key to the damage. Damage level is measured through agarose gel electrophoresis after Escherichia coli DNA is irradiated with an APP jet (APPJ) by placing it directly beneath the jet tip. Within the jet, some of the ROS and RNS diffuse into the surrounding atmosphere and molecules from the atmosphere may also come into the jet stream. In an attempt to minimize this effect, a gas curtain between the APPJ and the surrounding air was created by flowing different gases at different flow rates around all sides of the jet, in the same direction as the jet. When shielding gases were used, the intensity of DNA damage increased, illuminating more about reactive species' role in damage and affirming that the gas curtain improves APPJ effectiveness.

The Effect of Stacking Fault Energy on Texture Transformation in Thin Metal Films

Heather Phillips, Yan Tang, and Brandon Hoffman, Houghton College

Texture transformations in copper were observed via XRD. Previous studies have shown that minimization of nanotwin boundaries provides the driving force for texture transformations in silver thin films. Due to the larger stacking fault energy of copper, it was expected that copper films would have fewer nanotwins and, therefore, less transformation. Copper was deposited onto six silicon substrate via e-beam physical vapor deposition. Samples were annealed at either 200°C or 400°C for 2-6 hours. Texture was characterized via XRD before and after annealing. Results show no transformation in any of the samples studied.

Characterization of Spin-Coated Perovskite Thin Films
Samuel Fordin, Professor Yongli Gao, Ben Ecker and Congcong Wang, University of Rochester

Over the past five years, metal-organic perovskite solar cells have seen notable efficiency increases. However, as the field has expanded, the stability of the material under certain environments, in particular moisture, light, and oxygen, has been identified as and has remained a major barrier to its commercial viability. To address this issue, we systematically examine properties of different types of metal-organic perovskite thin films by means of surface analysis techniques, including x-ray, ultraviolet, and inverse photoemission spectroscopy. For this project, we sought to develop a method for creating spin-coated perovskite thin films to analyze and compare against coevaporated thin films and single-crystals. The compositions of the films were analyzed using x-ray photoemission spectroscopy and imaged with a scanning electron microscope. These results indicate that the thin films had a reasonable elemental composition ratio when compared to other thin films developed outside of vacuum systems. Improvements could be made to the materials and procedure, particularly in reducing the effects of the environment in which the films are grown.

Measurement of the 6He Decay Produced by the 9Be(n,alpha)6He Reaction
Katelyn Cook, Micah Coats, Mark Yuly, Stephen Padalino, Craig Sangster and Sean Regan, Houghton College, SUNY Geneseo, Laboratory for Laser Energetics

The OMEGA laser at LLE is routinely used to implode gas-filled capsules to study light ion fusion reaction rates of interest to stellar nucleosynthesis. As a first step toward a possible measurement of the 3H(t, gamma)6He radiative capture reaction, a detector system capable of measuring the 801 ms half-life of 6He has been developed and is being tested using 6He nuclei produced via the 9Be(n, alpha)6He reaction. Deuterons from the SUNY Geneseo tandem Pelletron produce neutrons in a thick deuterated polyethylene target via the 2H(d, n)3He reaction. These neutrons are allowed to strike a beryllium target placed in front of a silicon ΔE-E detector telescope, which is used to identify the particles from 6He decay. Following an approximately five second long activation period, the beryllium sample is immediately counted for about five seconds. The pulse heights for each detector and the timestamp are recorded using a specially configured femtoDAQ acquisition system and used to measure the decay curve.

Funded in part by a grant from the DOE through the Laboratory for Laser Energetics.

Validation of the gFR Computational Fluid Dynamics Methodology
Dan Eager, Houghton College

There is a current demand in computational fluid dynamics (CFD) for higher-order solvers that can simulate fluid flows using unstructured grids. Such software would allow for highly-accurate simulations of complex and industrially-relevant geometries. To help meet these needs, a new code, gFR, is being developed by researchers at the NASA Glenn Research Center. It is based on the flux reconstruction (FR) methods of H.T. Huynh, which are used to solve the three-dimensional Navier-Stokes equations. The methodology is capable of performing efficient and accurate large eddy simulations (LES) and, depending on user-specified choices, can recover many popular high-order methods including the discontinuous Galerkin, spectral difference, and spectral volume methods. Runge-Kutta methods are used to advance the governing equations in time. While gFR has many theoretical advantages, it had only been tested on two problems prior to the present work: a two-dimensional inviscid vortex and the Taylor-Green vortex problem. The present study at Houghton College includes tests of laminar flow over a flat plate as well as laminar channel flow over a backward-facing step. Preliminary results are shown for the two test cases and compared with corresponding experimental and theoretical results. Challenges are described and possible future work is outlined.

Particle Motion in kappa-Poincare Symmetry
Tom Brick, CUNY - City College of New York

Kappa-Poincare algebra is the symmetry of a modification of the special theory of relativity, which is motivated by considerations of quantum gravity. We consider the realization of this algebra in terms of standard canonical commutation rules. The action for the motion of point-particles is analyzed for three cases: free particles, charged particles in an electromagnetic field and particles in a gravitational field.

SESSION IIIA. ASTRONOMY AND ASTROPHYSICS

Analyzing TeV Gamma-Ray Binary Candidates with the HAWC Observatory

Ryan Rubenzahl, University of Rochester

So far there have only been 5 binary systems observed in the TeV gamma-ray range: LS I +61 303, HESS J0632+057, LS 5039, PSR B1259- 63 and 1FGL J1018.6-5856. Gamma-ray binaries consist of a normal O or Be star with a compact high-mass companion, such as a neutron star or black hole. The High-Altitude Water Cherenkov Gamma Ray Observatory, or HAWC, is an observatory located in Puebla, Mexico that utilizes the water-Cherenkov technique to detect gamma rays. Three of these binaries lie in the field of view of HAWC, which is fully capable of observing these rare binary systems. We look to confirm previous observations by other collaborations by observing the gamma-ray binaries LS I +61 303, HESS J0632+057, and LS 5039. These sources should exhibit periodicity in the flux of gamma rays over time, corresponding to the orbital period of the system. To observe this, we analyze 444 days of data from HAWC between November 26th 2014 to February 12th 2016. We fit a simple power law spectrum and use a maximum likelihood and MCMC calculation to determine the daily integral flux from each source. We then use a Lomb-Scargle Periodogram test to detect periodicity in the lightcurve. The sources LS I +61 303 and HESS J0632+057 are further studied to look for signs of flares and high-states of flux respectively.

Refining the Supernova Event Significance Calculation in IceCube

Cameron Ziegler, University of Rochester and SUNY Geneseo

The IceCube detector in the South Pole can detect neutrinos from core collapse supernova using 5160 Digital Optical Modules (DOMs). However, cosmic rays can produce hits that appear similar enough to neutrino detection that a large number of false alarms occur. The current method used to reduce the impact of cosmic ray detection is computationally expensive and requires communication with systems that measure the atmospheric muon rates. Three different potential improvements to this method were examined, but none showed promise. Changing the significance calculation basis from a Gaussian to an exponentially modified Gaussian distribution fit the data slightly better, but did not improve reduce the false alert rate. The geometry of the DOMs in IceCube was examined between high and low significance time bins and no obvious tracks from cosmic rays could be seen to be accounted for. Looking at the covariance matrix for the DOMs didn't show any clear difference from a set of independent, identical Gaussian distributions, but a test statistic using the covariance matrix has not yet been calculated to see if there are more subtle differences that could be used.

The Search For A Standard Candle Effect in the Sloan Digital Sky Survey Quasar Database

Christopher Wahl, SUNY Brockport

Quasars are among the brightest objects in the universe. Their intense luminosities arise from an accretion disk surrounding a supermassive black hole. This project seeks to identify a standard candle effect among quasars – to find sets of quasars whose spectra are identical, with observed magnitudes depending only on distance.

The Sloan Digital Sky Survey Quasar database was queried for quasars over the redshift range of [0.46, 0.82], brighter than $g \geq 19$. Spectral flux densities were re-sampled onto regular wavelength intervals and shifted into rest frame. The bins and intervals were spaced such that rest frame wavelengths were integer values separated by 1 Å.

The spectra were organized into redshift selected bins of $\Delta z = 0.01$. Composite spectra were generated for each redshift bin. A scaling and χ^2 matching system was used to compare bin composites to the individual spectra. Matching was conducted over MgII and Hβ emission lines. Each well-defined spectrum was matched against the remaining members of successive redshift bins. The best fits for each bin were indexed and AB magnitude were generated. These matches were compared to an expected evolution generated using the current Flat CDM using standard values.

Ionospheric Scintillation and Radio Wave Propagation

Alexis Klimasewski, University of Rochester and Sandia National Labs

Electron density irregularities in the ionosphere generate rapid fluctuations in amplitude and phase of radio signals called scintillation. Modeling the ionosphere and scintillation effects, helps to better understand the propagation of GNSS signals. WBMOD, an ionosphere model, was evaluated and compared to data to determine its efficacy in scintillation prediction.

SESSION IIIB. INSTRUMENTATION/EXPERIMENTAL TECHNIQUES

Solar Tracker Using an Arduino

Miranda Marnes, Siena College

The purpose of this project was to determine whether or not a photovoltaic cell (PV) that tracks the sun is more efficient than a stationary PV, given the electrical requirements of the motor and light sensors. We were particularly interested in the difference in efficiency for upstate-NY weather when there are many overcast days, which results in more diffused light. I designed and built a device to automatically rotate to follow the sun as it moves across the sky. This device uses an Arduino Uno, two photo-resistor sensors, and a servo motor that, depending on the amount of light reaching each sensor, rotates either in the posit1ive or negative phi direction. The progress and status of this project will be presented.

Computational and Experimental Analysis of the R.I.T e-NABLE Arm

Elisha Cheeran, Dr. Graziano Vernizzi, and Dr. Gregory Byrnes, Siena College

In the recent years, three-dimensional printing has become popular, especially in the field of prosthetic limbs. The e-NABLE community is a non-profit organization that uses 3D printing to make various prosthetic limbs. Though there is much done with the designing and 3D-printing of a variety of arms, hands, and limbs, there is a lack of structural analysis. The purpose of this research was to analyze the arm on a computational and on an experimental level and analyze different aspects of the 3D-printed arm. To analyze the Rochester Institute of Technology (R.I.T.) arm, we wrote software to characterize main mechanical properties of the arm: dimensions, moment of inertia, and center of mass of the arm were calculated directly from the original STL files, by using Octave/Matlab computational platform. For the experimental analysis, an apparatus was made to measure the grip strength of the hand versus the input force. Moreover, we measured the material strength of the infills that were programmed into MakerBot. The collected data show that the R.I.T arm is not as sufficient to pick up thin or short blocks with adequate grip strength, that can mimic the structure of something such as a pencil or other small objects. The input force that is needed to produce a strong grip is generally stronger than what a child can produce with her/his limb. This research opens a number of questions that can lead to major improvements for 3D-printing prosthetic arms.

VIPER Telescope

Zachary Rahilly and George Hassel, Siena College

The VIPER telescope was donated to Siena College in 2012 and re-assembly has been an entirely student-driven project. VIPER is a radio telescope with an off-axis Gregorian optical design featuring a 2.1 primary mirror. The primary dish refocuses the incoming radio waves to a secondary mirror which focuses the light to a fixed point on the telescope. During the summer of 2015, I worked on a team that constructed and mounted the altitude drive motors on the telescope. We developed temporary manual motor controls to operate the telescope. The following summer, my colleague Jonathon Farrell developed automated motor controls for VIPER that utilize an angle encoder, an Arduino, and Simulink. This automated control system is part of an important development milestone for transit-mode observations. Previous students also constructed a 21-centimeter receiver from MIT-Haystack's SRT program.
This project compiles previous progress and serves primarily as a forerunner to future use of the VIPER telescope. The first goal for this project was to implement Jonathon's motor controls to move VIPER into a position where it can take a measurement. Previously we were required to manually alter the voltage of a power supply to activate the motors. The automation in the new controls allow for unprecedented precision in controlling the telescope. The second goal is to obtain an observation of the sun at the primary focus. Previous attempts to obtain a detection of the sun were unsuccessful. I aim to develop an observation protocol that allows future students and faculty to more easily use VIPER.

SEM Analysis of Commercial Materials

Michelle Lieu, Dr. G Vernizzi, and Dr. K Kolonko, Siena College

The project studied the particle distribution of commercial materials. The materials are synthesized by local companies in the Albany area. The materials used are silicone elastomers and multifunctional nonwoven carbon fibers. Images of the materials were taken using a scanning electron microscope (SEM) to obtain an enlarged image of the particles in the materials. Analysis of the SEM images used various Matlab functions. One of the main functions used was normalized cross-correlation (NCC) which is a pattern-matching method. The NCC function correlates a desired template with the parent image to locate particles in the image. The matched objects are then counted using the histcounts function to give the number of particles in a region of the material. The automatic particle-counting algorithm we adopted suffers from known pattern-matching issues. Future work will be to find a more accurate method of object counting by addressing the size and shape variance.

SESSION IVA. OTHER

Analyzing Homelessness Data Using Python

Sara Mahar and Matthew Bellis, Siena College

CARES is an Albany-based organization that "collaborates with and supports our community to create a system of care to prevent and end homelessness." We have been able to obtain a subset of the large amount of data on individuals who move through the homeless shelters and have been recorded by the homelessness Continuum of Care (CoC). However, the dataset is quite large and complex and packaged solutions like Statistical Analysis Software (SAS) or Excel are not always flexible enough to answer the questions of support providers. Using standard scientific-analytical tools such as Python and Jupyter notebooks, we have worked to develop open-source computing tools to interface with these data and create informative visualizations using matplotlib and plotly. The ultimate goal is to identify inefficiencies in the support being provided and opportunities for improved outcomes for the homelessness.

Bike Generator

Jordon Penor, Siena College

The design of a stationary-bike bike generator and a system to store the energy generated is presented. Modifications to the stationary bike include a front wheel substitution, a mechanical assembly to accommodate a belt, pulley and motor, a rechargeable deep cycle battery, and a readout display of voltage, current, and guidance for the rider. The design uses a motor attached to the top of the system storing the energy to generate electric current. The system is designed to recharge batteries at the proper voltage and current to avoid damage. The system is intended as a prototype for a college class in Bolivia to develop a series of bike generators to provide power on days when their power is not reliable.

Graphene Growth in the Presence of Background Gases
Alexander Sidou and Mayuka Sasaki, SUNY Brockport

Graphene, a 2D form of graphitic carbon, is an interesting material because of its unique properties. For instance, it has high tensile strength (130 gPa) and high electrical conductivity (15000 cm2V-1s-1). Graphene was first isolated by Andre Geim and Konstantin Novoselov at The University of Manchester in 2004 using Scotch tape and graphite. One of the remaining challenges preventing incorporation of graphene in technological devices is the lack of a synthesis technique that results in high crystal quality graphene. Silicon carbide is one potential growth substrate that is suitable for graphene growth. Growth of graphene on the carbon-terminated surface could potentially result in high quality graphene, but is not well understood. In order to study graphene growth on this surface, the effects of ambient gasses during growth, growth temperature and growth time must be studied systematically.
In order to systematically study graphene growth on SiC, an ultrahigh vacuum chamber was built. The system has a base pressure in the ultra-high vacuum (UHV) range, which is required to study the growth process in detail. In this work, we report on our progress in developing the experimental capabilities of our UHV chamber, including preliminary attempts at graphene growth.

Generating High Power Femtoseconds Optical Pulses Using a Yb:KGW Modelocked Laser
CDT Ian Greer, United States Military Academy

Ultra-short pulse, or modelocked, laser systems have enabled advances in pathogen deactivation, medical apparatus sterilization, and non-linear microscopy. These applications benefit from the high peak powers typically associated with modelocked lasers. In the scope of this project, we designed, built, and characterized a modelocked laser based on a Ytterbium doped Potassium-Gadolinium Tungstate (Yb:KGW) crystal. The cavity configuration uses passive modelocking and consists of a saturable absorbing mirror (SESAM) to generate pulses with a 3.5nm spectral bandwidth centered on a 1030nm wavelength. This bandwidth suggests pulses as short as 350fs with a repetition frequency of approximately 72MHz. The laser produced as much as 4.2W of average output power with 33W of input power from a 980nm pump diode. We estimate the peak output power of the laser to be on the order of kilowatts. We intend to use the short pulses of this laser for non-linear microscopy to generate images with a high temporal resolution, allowing for imaging of incredibly fast processes. Furthermore, similar Yb:KGW lasers built in the past have achieved multi-focal lensing, thus allowing an observer to take three dimensional images in real time.

Studying the Effects of Morphology on Conjugated Polymer Photophysics
Paul Wrona, University of Rochester

The photophysics of conjugated polymers is highly dependent on the interaction of a polymer with the surrounding solvent. Single-chain experiments must be performed in various solvent conditions in order to systematically observe how the morphology of a polymer affects its excited-state lifetime, spectrum, and macroscopic intensity over the course of an experiment. We developed MATLAB code to model a typical single-chain experiment using different solvents. In addition to discussing how lifetimes, spectra, and intensities are correlated with each other, we will describe how we must treat features like aggregation and photooxidation in order to simulate observed phenomena.

Characterization of the NEOCam Infrared Detector Arrays
John Piotrowski, University of Rochester

By characterizing the infrared detectors designed for the Near Earth Object Camera, we are able to gain insight on how the devices will operate in the harsh conditions of space. The detectors operate at a wavelength sensitive the black body emissions of local asteroids which allows us to detect a wide variety of objects that currently remain unobservable. The NEOCam mission will further help us to both catalog NEOs that could be a potential hazard to Earth in addition to permitting us to study their origin and fate in our solar system.

SESSION IVB. NUCLEAR AND PARTICLE PHYSICS & INSTRUMENTATION/ EXPERIMENTAL TECHNIQUES

A Parity Violation Experiment for Undergraduate Laboratories

Michael Ganger, Houghton College

The discovery of parity violation in weak interactions was a foundational discovery of the 20th century, first proposed by Lee and Yang in 1956 and experimentally verified by Wu in 1957. Lee and Yang also proposed a simpler experiment which does not require that the 60Co source be polarized. Randomly oriented 60Co beta decays to an excited state of 60Ni, which then de-excites by emitting two γ-rays. Conservation of angular momentum ensures that the spin of all emitted particles are aligned. Therefore, when a γ-ray and a β-particle have antiparallel momenta they necessarily have opposite helicities. In the proposed experiment, the circularly polarized γ-rays are transmitted through a steel rod magnetized along the axis between two collinear detectors, a Ge detector for the γ-rays and a Si detector for the β-particles. Due to the slight dependence of the Compton cross-section on the relative orientations of the γ-ray and the electron spins in the magnet, a parity violating asymmetry could be observed by comparing β-particle and transmitted γ-ray coincidence count rates for opposite directions of magnetization. An experiment to observe effect this is currently being prepared at Houghton College using modern techniques suitable for an undergraduate laboratory.

Brane Brick Models and 2d (0,2) triality

Simon Gurvets, City College of New York

In this talk, I will discuss recent progress in understanding 2d (0,2) quiver gauge theories using brane brick models. Brane brick models are Type IIA brane configurations T-dual to D1 branes probing singular toric Calabi-Yau 4-folds. These brane configurations fully encode the 2d (0,2) theory on the worldvolume of the D1 branes. Gadde-Gukov-Putrov triality can be implemented as local mutations of the brane brick models. With these tools, the triality networks of several interesting theories were constructed, including examples of networks which are not simply connected.

E-NABLE Pedometer
Alexander Warn, Siena College

My project was to design and build a pedometer that can attach to an e-NABLE arm. E-NABLE is an organization that designs and 3D prints hands and arms for people in need. The pedometer uses a Teensy microcontroller and an accelerometer to measure the steps while on the user's wrist. The pedometer will be compared to a commercially available pedometer. Using a CAD software, the pedometer is designed to fit on an existing e-NABLE arm design. I hope this project inspires other people to design and build more accessories to improve the experience for the recipient.

Gravity Battery: Energy Storage Using Gravitational Potential Energy And A Bike Dynamo
Jamie Bedard and Matt Bellis, Siena College

For my advanced lab project I designed and built our own version of a gravity battery. A gravity battery makes use of gravitational potential energy for storage. By lifting a mass up to some height the energy is stored as gravitational potential energy. When the mass is allowed to fall, the linear motion is converted to rotational kinetic energy through a series of gears, which can then be coupled to a dynamo, generating electricity. The current design uses a series of 3D printed gears, which is economical but not very precise. We will present what we have learned through this process including both the successes and the challenges.

Charging a Battery with a Solar Panel
Joseph Caldara III, Siena College

In Bolivia, many school children face unreliable power. Because of this, there are days where students are sent home from school. Although it does not happen often, this is still a problem that needs to be fixed. The solution being sought after is using a solar panel to charge a battery to provide adequate power to the classroom for necessary items such as light bulbs and electronic devices. Testing at this point in time has proven that the battery can be charged using the solar panel. A power inverter is connected to the battery that allows any device to be used, regardless of what power type is needed. There is a noticeable change in the efficiency of the solar panel to charge the battery depending on the weather conditions. Under direct sunlight the panel provides over two amps of current which charges the battery at an effective rate. However, when the conditions are less clear and clouds are prevalent in the sky, the amount of current flowing to the battery drops immensely. The direction of continued research is to determine the amount of time that the battery can provide power for certain devices. The length of time the battery will last will be found by solving for the state of charge and applying that to the amount of charge that is necessary for a given device to run. Based on these conclusions, the number of batteries required to power a classroom will be determined.

LIST OF PARTICIPANTS

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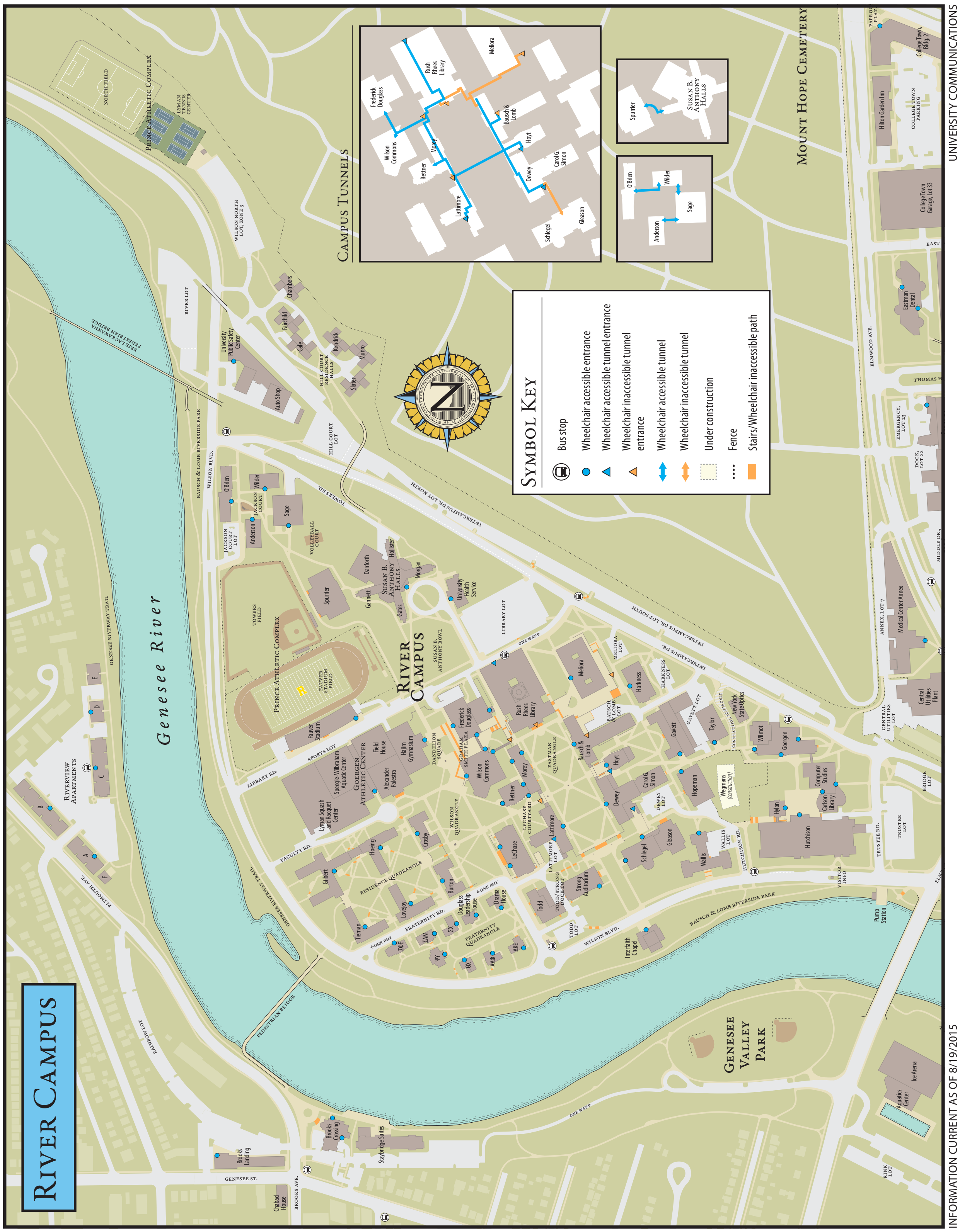
River Campus
Campus Tunnels
Symbol Key
Bus stop
Wheelchair accessible entrance
Wheelchair accessible tunnel entrance
Wheelchair inaccessible tunnel entrance
Wheelchair accessible tunnel
Wheelchair inaccessible tunnel
Under construction
Fence
Stairs/Wheelchair inaccessible path
Genesee River
Mount Hope Cemetery
Genesee Valley Park
Prince Athletic Complex
Goergen Athletic Center
Rush Rhees Library
Wilson Commons
Riverview Apartments
University Communications
Information current as of 8/19/2015