XXXIX

Annual

Rochester Symposium for Physics (Astronomy & Optics) Students

Department of Physics and Astronomy

SPS Zone 2 Regional Meeting

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

L S I

CHANJU (ZOE) YOU	13:45	ROOM 1
GEORGE ZHANG	09:45	ROOM2
GEORGE ZHANG	10:40	

C O T IC HOS P ESMO S R P I A R OSOD MSA N R N
T T TC O OP S S N SE U
T OP S SO NA L M E I MGER

O P A M G R R

C A M O T M O P E A F F E O L N F S O N O R S E K I U S E R E R

T A M A T M O A S A S S O N O D M S A N A O N P S R H S S I R

C O A S S N H P H A F C O S N A D E S N R K E G E R E

9:00 AM M D E M E P
Ian K. Bania, Colgate University

9:15 AM D M P P S
Cosmin Ilie, Caleb Levy, Jacob Pilawa, and Saiyang Zhang, Colgate University

9:30 AM T N S B T N E S B
Rebecca Coglianese, Manhattan College

9:45 AM P A I
Vanessa Havens, Siena College

10:00 AM T M G A L S
Ashley Martsen, Jeyhan Kartaltepe, Michael Lam, Fred Moolekamp, RIT, RIT, RIT, Princeton

10:15 AM E S

T A MT T A M O T STSS BEN M NAS CI N EP M IA LRU ENI E HNE R SQ E
C T C DLAC AN A P EL P U IHER S I R

C CO T A SS ON PHA E AI O THD B R KS L HA ROERG O E PE R K

9:00 AM L L P S OII M

TAM AMO SOSSPENIOIS SESSENIR

DOBTENURU
Fred Genier, Mark Rosenberry, Graziano Vernizzi, Siena College

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C TCO SA SSTBCPHH F OVM C E ON LR. IBA OE G O E PER R K R

11:30 AM **T A P**

Justin Marotta, Natalie Stagnitti, Siena College

11:45 AM **E O B**

S F

T T M P C O S O S S B N D I I P H E S I R

C C O C T A S S B D P H A F I A A N E O I R E B R L A S E D S L E N E R G E E

11:30 AM **F N M F N M S N S**

Vincent Meunier, David Clymer, Rensselaer Polytechnic Institute, Northeastern University

11:45 AM **M F H I**

Colin Dixon, Colgate University

12:00 PM **H M M H I**

Abby Lupi, Tania Kleynhans, David Messinger, Rochester Institute of Technology

12:15 PM **A M A M R P**

Blyden Nartey, Siena College

12:30PM **B**

Daniel Whinnery, Siena College

C M P M P L A N B H E U R K

T M M O S S B V D D M A M A O N P S R H S S I R

C C O A S S E P H D F A I L A M D E N H R O S N A U N E I U R

1:15 PM **C A B F**
Chad Popik, University of Rochester

1:30 PM **D E I**
M G A
Joshua Ratajczak, Satya Gontcho A Gontcho, Regina Demina, Zachery Brown, Gebri Mishtaku, University of Rochester

1:45 PM **C G**
Yifan Zhang, University of Rochester

2:00 PM **A II F Q**
Stella Van Ness, SUNY Brockport

2:15 PM **D S V**
A S B H
Xi Yek (Zach), SUNY at Fredonia

2:30 PM **D T D E M**
H
John Yevoli, Manhattan College

limit. This upper bound on luminosity provides a way to place projected bounds on the DM-proton scattering cross-section well below current direct detection experiments in the sub-GeV region. Thus, the mere observation of population III stars, a promising prospect with the new James Webb Space Telescope, can be used to constrain this key dark matter property in previously unexplored regions of parameter space.

T N S B N R E S B

Rebecca Coglianese, Manhattan College

We studied the properties of neutron stars using a model of extra-dimension, known as braneworld theory, and utilized a state-of-the-art nuclear equation of state. This is an important research area as it advances our understanding of the fundamental laws of nature and explores the possibility of a warped geometry and a higher-dimensional universe, using compact objects as astrophysical laboratories. In particular, we found that the brane tension can enhance the observed mass of the compact object. Given the nuclear physics constraints on the equation of state and the astrophysical limit of the maximum mass of the neutron star, we set a lower limit on the brane tension.

P A I

Vanessa Havens, Siena College

Asteroids of all sizes orbit within our solar system, some come close to Earth and some far away. While the collision threat from asteroids is well known, we can learn about the formation of the Solar System by studying the orbital properties and composition of asteroids. Using the Siena College Breyo observatory, I have been and plan to continue tracking asteroids, focusing on the asteroid Danae. With the data processed, I will then analyze the images taken using the programs DS9 and AstroImageJ to measure a light curve of the asteroid. By looking at light curves you are able to see the variations in the light reflected from the asteroid which helps to determine the shape of the asteroid and its rotation period. We plan to obtain spectra to analyze the asteroid's chemical characteristics. The chemical composition and any absorption lines can help us to determine the region where the bcharoid

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T T T O T STSS BEN M NAS OI N EP M IA LR U EN I E HNE R SQ E U
C T C DLAC AN A P EN P U IH BR S I R

L L P ST O II M L U P
Lucas Berens (1,2), Nicole Neveu (1), Lipi Gupta (1,3), 1: SLAC National Accelerator Laboratory, 2: Rochester Institute of Technology, 3: University of Chicago

An upgrade to the Linac Coherent Light Source (LCLS) is currently under construction (LCLS-II). Simulations of the photoinjector are used to better understand and predict beam quality under different operating conditions. These simulations, however, do not currently account for the transverse laser profile at the photocathode. We present results on using transverse laser profiles from Virtual Cathode Camera (VCC) images to optimize LCLS-II photoinjector simulations. We have used these VCC images as initial transverse particle distributions for ASTRA photoinjector simulations, as opposed to ideal particle distributions. We also pr

G P AD P A

Yue Wang, University of Rochester, SLAC National Accelerator Laboratory

Common anomalies in particle accelerators are point anomaly, shift anomaly, and drift anomaly. The current troubleshooting procedures for the accelerator at SLAC are resources and time consuming. A method that is able to detect anomalies in real-time and report a list of potential causes of the anomalies will be presented in this talk. Gaussian Process (GP) fits the signal functions from limited noisy observations. GP was used to calculate the functional values and the derivatives in real time. Furthermore, we classified and visualized points leading to an anomaly using the predicted values with a matrix. We demonstrated the method on a Toy Model and accelerator simulation data set.

L C P C S C C A S A S

Aaron Flowers, George Zhang, Saleem Ali, Dr. Paula Fekete, United States Military Academy

The purpose of this research project is to utilize Chip Scale Atomic Clocks (CSACs) to create an accurate local positioning system that can operate as a contingency to the conventional Global Positioning System. GPS measures the time it takes for radio signals to travel to and from a receiver to calculate the pseudorange between the receiver and its corresponding satellites. We investigate this concept employing smaller, ground-based handheld devices that are rapidly deployable with ground-based receivers and receivers onboard low altitude balloon satellites. We show that our local positioning system can operate using hand portable CSACs that will accurately measure the time it takes for radio signals to travel to and from a receiver at closer distances, while accounting for time dilation due to altitude differences. Using the process of trilateration, we find an accurate distance and location between the receiver and three other CSACs. This local positioning system is expected to be useful for situations where GPS is unavailable such as in high pressure deployment situations for the military, as well as in places where GPS satellites cannot reach such as underground locations.

is an open-source software package which bridges this gap. SNEWPY can interface with supernova simulation data to generate a time series of neutrino spectra at Earth which it can then use to calculate the neutrino event rates as seen in the detector.

T O SOSSPEN I OIB S BS EN I R

DO B T EN U R U

Fred Genier, Mark Rosenberry, Graziano Vernizzi, Siena College

The asteroid 2010 TK7 is currently the only known Earth trojan object, oscillating about the Sun-Earth L4 point. The first goal of our project is to attempt to simulate 2010 TK7's orbit using the Python n-body integrator REBOUND. Additionally, we seek to test whether a passing near-Earth object could perturb 2010 TK7's orbit enough to free it.

P E U

T M L D U I D

Amanda Wasserman, Vashisth Tiwari, Segev BenZvi, University of Rochester, for the Dark Energy Spectroscopic Instrument (DESI)

T C O DT A S SSTE A O A I L E C P N I A H S S O M N Q P S I U U

T A C C P R
Justin Marotta, Natalie Stagnitti, Siena College

Many undergraduate students find it difficult to visualize 3D concepts in physics, chemistry and engineering courses. There is a need for context-specific spatial visualization activities to help students connect 2D representations to 3D models. We have assembled an interdisciplinary team of undergraduate physics, chemistry, and computer science research students and faculty to create 3D, augmented reality (AR) models of physics concepts including centripetal force, torque, electric and magnetic

ory an, elesosce,

operations compete with the thermalization, and we show that the engine approaches a steady state where it operates with finite efficiency.

[redacted]

H M M H I

Abby Lupi, Tania Kleynhans, David Messinger, Rochester Institute of Technology

Whether by intentional erasure or weathering from the elements, some historical texts are damaged beyond recognition... or so we thought. The Rochester Cultural Heritage Imaging, Visualization, and Education (R-CHIVE) research group at RIT analyzes data from multispectral and hyperspectral images to reveal text that is otherwise invisible to the naked eye. This research compares hyperspectral (HSI) and multispectral imaging (MSI) using language that is accessible to non-scientists. In particular, we distinguish the merits of HSI v

B

Daniel Whinnery, Siena College

Decision trees and random forests are generated by the recursive binary partition of a given dataset. The goal is to increase the diversity (or information content) of the data among different partitions. That task is usually achieved by minimizing informa

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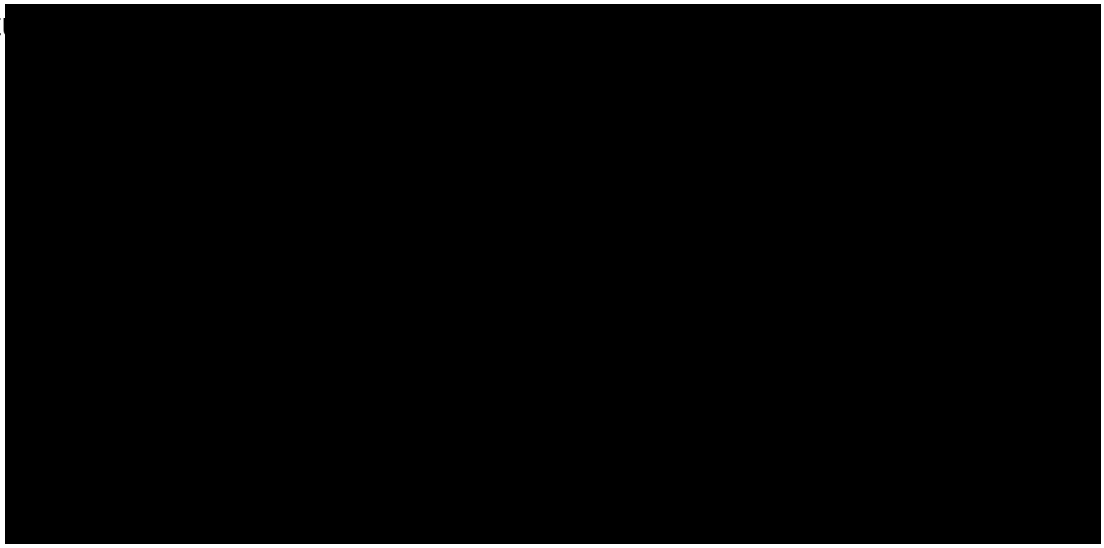
C O CA S C S O T L V B A I L E D O I D H C S S I M N S E F E H E S S I R

A D E M D D Y A
Keontré I. Hughes, Colgate University

Chronic vitamin D deficiency is a relatively common condition worldwide. We studied a mix of vitamin D binding proteins and model membranes, with the goal of understanding struct



S D S N N D Q S U

ChanJu (Zoe) You, Colgate University

Quantum state diffusion is a useful modeling technique when it comes to understanding the interaction between a quantum system and its surroundings, in other words - an open quantum system. Here, we examine its usefulness in studying spin noise

where 100-fs-wide optical pump pulses with photon energy above the Bi2Se3 bandgap create hot electrons, while time-delayed probe pulses (100 fs) measure electron relaxation dynamics. The results are modeled based on the time evolution of nonequilibrium/hot carrier concentrations within the material. During this relaxation process excess energy is converted into lattice vibrations creating CAPs. Half of the Bi2Se3 samples were deposited directly on a silica substrate and the other half had a graphene nanolayer between the Bi2Se3 and silica. We measured both transmissivity (T) and reflectivity (R) transients simultaneously, since this way we can find the absorbance (A) changes, using the relationship T + R + A = 1. The simultaneous experiments in both the reflection and transmission mode, gave a holistic view of the electron lifetimes as well as CAP generation and their respective lifetimes.

C E I

Aroon Pressram, Siena College

Creating a cost-efficient ionization chamber can serve as an effective learning tool for students interested in areas of applied physics that focus deeper on radiation (e.g. Medical Physics, Nuclear Physics, Linac engineering). Many simplified ionization chambers are made by building a Darlington pair circuit. For the purposes of delivering a more accurate and reliable ionization chamber, I used a 4-pair Darlington circuit following C. Wentzel's design as opposed to a single-paired Darlington circuit. This is due to the single pair circuit’s susceptibility to temperature and stray electrical fields, both of which cause imprecise fluctuations in the reading. Several prototypes were made on a Protoboard and soldered into mini-solder boards, which then went into the chamber. I decided to create and utilize a printed circuit board (PCB). This would show the placement of each component, preventing problems that other

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T T O S S S B V D D M A M A O N P S R H S S I R

C A B F

Chad Popik, University of Rochester

Around 10 billion years after the big bang, the expansion of the universe began to accelerate from what is referred to as dark energy. To understand dark energy, we must study the expansion of the universe at this epoch, which is done by observing astronomical structures of fixed size, known as standard rulers. One such structure is the imprint left on the galaxy distribution by Baryon Acoustic Oscillations (BAOs), which we observe through the survey of millions of galaxies. In our research, we have developed the algorithm CenterFinder to find probable centers of BA

parameters for these components that, when combined, best fit the overall rotation curve of these galaxies. We fit both the one dimensional rotation curve (rotational velocity as a function of galactocentric radius) and the two dimensional H velocity map (observed gas velocity along the line of sight at each location on the galaxy). The two dimensional velocity map requires solving for both the inclination angle i and phase angle with the respect to the semi-minor axis of the galaxy. Once the fitting is completed, we use these parameters to further study the distribution of dark matter within the galaxy.

A II F Q

Stella Van Ness, SUNY Brockport

Quasars, the most luminous objects in the Universe, are powered by accretion onto supermassive black holes. Since they can be seen to great distances, they can be used as beacons to study the intervening gas along the line of sight. Eleven quasar fields were identified with potential absorption due to singly ionized calcium (CaII), which can be used to identify galaxies in the low-redshift Universe. Imaging and higher-resolution multi-object spectroscopy of the quasars and galaxies in these fields were obtained from the Gemini North 8-m telescope. After data reduction and spectral extraction, we are using the higher resolution data to confirm that the CaII absorption in the quasar spectra is real, and to measure the strength of CaII absorption in these regions. The Gemini imaging and spectroscopy of the galaxies will then be used to identify the galaxies at the absorption redshifts.

D S AGV S B H

Xi Yek (Zach), SUNY at Fredonia

We present new 233 GHz continuum observations collected using the Atacama Large Millimeter/Submillimeter Array (ALMA) on the newly discovered FU Orionis candidate HBC722. Previous millimeter continuum data from the Submillimeter Array (SMA) failed to detect this object, ruling out the possibility of the burst being triggered by gravitational instability in a massive disk. With these data we detect HBC722 at millimet t t t

has a disk-to-star mass ratio of approximaer

T T T C L O A PS AI P N IS R

N	S	I
Saleem Ali	Undergraduate Student	United States Military Academy
Daniel Allspach	Undergraduate Student	Siena College
Alaina Attanasio	Undergraduate Student	University of Rochester
Ian Bania	Undergraduate Student	Colgate University
Lucas Berens	Undergraduate Student	Rochester Institute of Technology
Grant Block	Undergraduate Student	Rensselaer Polytechnic Institute
Genyu Chen	Graduate Student	Materials Science
Jing Cheng	Graduate Student	University of Rochester
Charles Chimera	Undergraduate Student	University of Rochester/LLE
David Clymer	Undergraduate Student	Rensselaer Polytechnic Institute
Rebecca Coglianese	Undergraduate Student	Manhattan

Jillian Paulin	Undergraduate Student	Colgate University
Silvia Peiro	Undergraduate Student	Roberts Wesleyan College
Yinglei Peng	Undergraduate Student	University of Rochester
Susanna Phillips	Undergraduate Student	Roberts Wesleyan College
Chad Popik	Undergraduate Student	University of Rochester