XXXIII

Annual

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

April 5, 2014

Department of Physics and Astronomy
University of Rochester
Rochester, NY 14627-0171

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

Rochester, April 5, 2014

Dear Participants:

Welcome to the 33rd 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/2014/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 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	LOCATION	TIME
Salina Ali	B&L 208	10:30 AM
Betty Anderson	B&L 109	2:30 PM
Brittany Barrett	B&L 106	11:30 AM
Jessica Bruckner	B&L 208	10:30 AM
Ryan Challener	B&L 208	10:30 AM
Robert Chancia	B&L 106	11:15 AM
Xinru Cheng	B&L 106	9:45 AM
Jonathan Delehanty	B&L 106	2:15 PM
Mary Rose Devine	B&L 109	2:15 PM
Stephen Doud	B&L 106	9:00 AM
Sara Frederick	B&L 208	10:30 AM
Julian Girard	B&L 208	10:30 AM
John Grossmann	B&L 106	2:45 PM
Garrett Hartshaw	B&L 109	11:30 AM
Shauna LeFebvre	B&L 208	10:30 AM
Philippe Lewalle	B&L 208	10:30 AM
Daniel Loman	B&L 208	10:30 AM
Thomas Loughlin	B&L 106	9:15 AM
Ian Love	B&L 109	11:45 AM
James MacNeil	B&L 106	9:30 AM
Jonathan Martin	B&L 109	9:45 AM
Anna Miettinen	B&L 109	2:00 PM
Emily Morrow	B&L 109	9:00 AM
Sylvia Morrow	B&L 208	10:30 AM
Natalie Mundt	B&L 109	10:00 AM
Jennifer Newcombe	B&L 106	10:15 AM
Ethan Ocock	B&L 106	2:30 PM
Tyler Rauenzahn	B&L 106	2:00 PM
Colby Raymond	B&L 109	10:15 AM
Ronnie Rera	B&L 106	11:00 AM
Katherine Robinson	B&L 208	10.30 AM
Ali Ropri	B&L 106	10:00 AM
Daniel Schussheim	B&L 109	9:30 AM
Michael Senatore	B&L 106	3:00 PM
Robert Sims	B&L 109	11:15 AM
Dillon Skeehan	B&L 109	11:00 AM
Anthony Smith	B&L 208	10:30 AM
Sylvia Thomas	B&L 208	10:30 AM

NAME	LOCATION	TIME
Chan Tran	B&L 208	10:30 AM
Nguyen Truong	B&L 208	10:30 AM
Ashley Tucker	B&L 109	9:15 AM
Jaime Vela	B&L 208	10:30 AM
Lucas Viani	B&L 208	10:30 AM
Daniel Wysocki	B&L 106	11:45 AM

XXXIII – 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 (B&L 109)

Prof. Frank Wolfs, University of Rochester.

8:50 AM: SPS (B&L 109)

Prof. Sean Bentley, Adelphi University

9.00 AM – 10:30 AM: SESSION IA. CONDENSED-MATTER PHYSICS (B&L 109)

SESSION CHAIR: PROF. MOHAMMED TAHAR, SUNY BROCKPORT

9:00 In-situ EBSD Study of Texture Transformation in Thin Ag Films
Emily Morrow, Ethan Ocock, and Brandon Hoffman, Houghton College; Markus Chmielus, Elizabeth A. Ellis, and Shefford P. Baker, Cornell University.

9:15 Effect of Substrate Annealing and Seeding on ZnO Nanowires Synthesized Using a Hydrothermal Method
Orlando Lopez, Ashley Tucker, Kimberly Singh, Spencer Mamer, Mostafa Sadoqi, and Huizhong Xu, St. John's University

9:30 Interaction of vortices and discrete breathers in Josephson junction ladder
Daniel Schussheim, Colgate University

9:45 Frequency Synchronization of Coupled-Oscillating Josephson Junctions
Jonathan Martin, Colgate University

10:00 X-Ray Diffraction of Indium Film
Natalie Mundt, SUNY Brockport

10:15 Quantized Conductance of Nano-contacts
Colby Raymond, SUNY Brockport

9:00 AM – 10:30 AM: SESSION IB. QUANTUM OPTICS AND OPTICAL TECHNIQUES (B&L 106)

SESSION CHAIR: SEAN BENTLEY, ADELPHI UNIVERSITY

9:00 The Faraday Rotation Effect
Stephen Doud, SUNY Brockport

9:15 Lock-In Detection
Thomas Loughlin, SUNY Brockport

9:30 Single-Emitter Nanocrystal Characterization and Manipulation for Room-Temperature Single Photon Source Applications
J. MacNeil, J. Winkler, D. Mihaylova, E. Shockley, and S.G. Lukishov, University of Rochester

9:45 Generation and Measurement of Two-Qubit Single-Photon States
Xinru Cheng, Colgate University

10:00 Development and Utilization of the Tel-X-Ometer
Ali Ropri and Dr.McColgan, Siena College

10:15 The Design and Construction of an X-ray Diffractometer
Jennifer Newcombe and Brandon Hoffman, Houghton College

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

Proton-Induced X-Ray Emission Analysis of Crematorium Emissions
Salina F. Ali, Benjamin J. Nadarski, Alexandrea D. Safiq, Jeremy W. Smith, Josh T. Yoskowitz, Scott M. Labrake, and Michael F. Vineyard, Union College

Improving Sophomore-Level Modern Physics Laboratory Equipment
Jessica Bruckner and Professor John Cummings, Siena College

Modeling the Dust Composition of Protoplanetary Disks in the Taurus Region
R. Challener, W. J. Forrest, and S. Fogerty, University of Rochester

Population Synthesis of Radio and Gamma-Ray Millisecond Pulsars
Sara Frederick, Peter Gonthier, and Alice K. Harding, University of Rochester, Hope College, and NASA Goddard Space Flight Center

Cosmic Ray Response of Megapixel LWIR Arrays from TIS (Teledyne Imaging Sensors)
Julian Girard, William Forrest, Judith Pipher, Craig McMurtry, Meghan Dorn, and Amy Mainzer, Siena College, University of Rochester, Teledyne Imaging Sensors, and NASA

An Investigation of the Rayleigh Scattering of Light
Shauna LeFebvre, Union College

Potentials at the Limits of their Existence: Particle-Vibration Coupling in the Nuclear Many-Body Problem
Philippe Lewalle, Elena Litvinova, Filomena Nunes, and Luke Titus, Michigan State University and University of Rochester.

Analyzing the effect of the Four Factors of Basketball Success on Offensive Efficiency
Daniel Loman and Matthew Bellis, Siena College

A Study of Weak Magnetic Focusing
Sylvia Morrow and Mark Yuly, Houghton College

Examining the Relationship Between Period vs. Diameter of Asteroids
Nicholas Powers and Anthony Smith, SUNY Oswego and National University of Taiwan

The Coincidence Efficiency of Sodium Iodide Detectors for Positron Annihilation
Thomas Eckert and Mark Yuly, Houghton College

Development of Synchronous Direct Digital Receiver System for Geospace Imaging Studies
Chan Tran, Meghan Harrington, Joe Kujawski, and Allan T. Weatherwax, Siena College

Energy-Dispersive X-Ray Fluorescence for Heavy Metal Quantification on Soil Products
Nguyen Truong, Dr. Zewu Chen, Jon Dunphy, and Dr. Michele McColgan, Siena College and X-Ray Optical Systems

Methods for Dispersing Long Single-Walled Carbon Nanotubes
Jaime C. Vela, Amanda Amori, and Todd Krauss, University of Rochester

Star Formation in the NGC 5846 Group of Galaxies
Lucas Viani, Union College

Robotics Beacon for Robot Positioning with Simulink
Katherine Robinson, Siena College

11:00 AM – 12:00 PM: SESSION IIIA. HIGH-ENERGY AND NUCLEAR PHYSICS (B&L 109)

SESSION CHAIR: PROF. MARK JULY, HOUGHTON COLLEGE

11:00 Opportunistic High Energy Physics Computing in User Space with Parrot
Dillon Skeehan, Paul Brenner, Ben Tovar, Douglas Thain, N. Vallis, A. Woodard, M. Wolf, T. Pearson, S. Lynch, and K. Lannon, University of Rochester and University of Notre Dame

11:15 Reconstructing Energy of Large Angle Muons in Neutrino Quasielastic Scattering Events
A. Bodek, R. Sims, M.E. Christy, and T. Walton, University of Rochester and Hampton University

11:30 A Measurement of the $^{12}C(n,2n)^{11}C$ Cross-Section for use as an Inertial Confinement Fusion Diagnostic
Garrett Hartshaw and Mark Yuly, Houghton College

11:45 Construction and Characterization of a Farnsworth-Hirsch Fusor
Ian Love and Mark Yuly, Houghton College

11:00 AM – 12:00 PM: SESSION IIIB. ASTRONOMY (B&L 106)

SESSION CHAIR: PROF. BILL FORREST, UNIVERSITY OF ROCHESTER

11:00 Observations of the Eclipsing Binary U Cephei using the SUNY Cobleskill Remote Observatory
Ronnie Rera & Edward Stander, Siena College and SUNY Cobleskill

11:15 Quasar Variability Measurements in Hubble Space Telescope Archive Data
Robert Chancia, SUNY Brockport

11:30 A Study of Ultra-Long-Period Cepheids
Brittany Barrett, Scott Lucchini, David ONeill, C. Ngeow, and Prof. S. Kanbur, SUNY Oswego

11:45 Principle Component Analysis of Cepheid Variable Stars
Daniel Wysocki, Zachariah Schrecengost, Earl Bellinger, Shashi Kanbur, Sukanta Deb, and Harinder P. Singh, SUNY Oswego

12:00 PM – 1:00 PM: LUNCH (DANFORTH DINING HALL, BLDG 48 ON PAGE 32)

1:00 PM – 2:00 PM: PHYSICS JEOPARDY (B&L 109)

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

SESSION CHAIR: PROF. JOHN MOUSTAKAS, SIENA COLLEGE

2:00 Bifurcations in the Synchronization States of Entorhinal Cortex Layer II Stellate Cells
Anna Miettinen, Colgate University

2:15 The Effect of Ion Channel Noise on Synchronization of Entorhinal Stellate Cells
Mary Rose Devine and Patrick Crotty, Colgate University

2:30 Synchronization of non-identical entorhinal cortex stellate cells
Betty Anderson, Colgate University

2:00 PM – 3:15 PM: SESSION IVB. EXPERIMENTAL TECHNIQUES (B&L 106)

SESSION CHAIR: PROF. DALE ZYCH, SUNY OSWEGO

2:00 CANCELED

2:15 Black Body Spectrometer
Jonathan Delehanty, SUNY Brockport

2:30 The Design and Construction of an Atomic Force Microscope
Ethan Ocock and Brandon Hoffman, Houghton College

2:45 Inexpensive Ultrasonic Interferometer for measuring changes of the speed of sound in materials
John Grossmann, Colgate University

3:00 Angular momentum transfer to strongly trapped absorptive particles via LG modes

Michael Senatore and Professor Catherine Herne, Colgate University

SESSION IA. CONDENSED-MATTER PHYSICS

In-situ EBSD Study of Texture Transformation in Thin Ag Films

Emily Morrow, Ethan Ocock, and Brandon Hoffman, Houghton College; Markus Chmielus, Elizabeth A. Ellis, and Shefford P. Baker, Cornell University.

When the crystals that make up silver thin films form, the crystal lattice structure generally forms a <111> orientation. Over time or from heat treatment, crystal reorientation can occur, producing a different texture with crystals of different orientations. The texture transformations of silver films with thicknesses of 1200 nm and 1800 nm were observed with and without titanium bi-layers between the SiOx substrate through the use of SEM and EBSD. It was noted that there was surface grain growth as well as substrate grain growth, and continued nucleation throughout annealing.

Effect of Substrate Annealing and Seeding on ZnO Nanowires Synthesized Using a Hydrothermal Method

Orlando Lopez, Ashley Tucker, Kimberly Singh, Spencer Mamer, Mostafa Sadoqi, and Huizhong Xu, St. John's University

ZnO nanowires have been extensively studied due to their remarkable mechanical, thermodynamic, electrical, and optical properties. Amongst the various ZnO nanowire synthesis methods, the hydrothermal growth method is quite attractive due to its simplicity and tolerable growth conditions. In this work, we apply the hydrothermal method to grow ZnO nanowires on gold-coated glass substrates and study how different pre-growth treatment of the substrate affects the morphology, distribution, and dimensions of the ZnO nanowires. We have found that pre-growth annealing of the substrate at 250 degrees Celsius is required to have vertically aligned nanowires. Our results have also revealed that the nanowire density and dimension are dramatically different for substrates with pre-seeded ZnO nanoparticles and unseeded substrates. The ZnO nanoparticle seeds play an important role in providing nucleation sites that are much smaller than the critical size of precipitation out of the solution, resulting in nanowires of smaller dimensions for pre-seeded substrates. The dependence of the nanowire dimensions on the precursor concentration for both pre-seeded and unseeded samples is also studied and discussed.

Interaction of vortices and discrete breathers in Josephson junction ladder

Daniel Schussheim, Colgate University

We provide a basic introduction to Josephson junction theory, and two nonlinear modes in a Josephson junction ladder: the vortex and discrete breather. We then present computational and experimental results as evidence for a vortex/breather interaction. We create a breather in the ladder then inject magnetic flux into the edge cell of the ladder to create a vortex. By increasing the array current, the vortex is sent down the ladder. We

argue that differences in junction switching currents on either side of the breather are evidence for pinning of the vortex by the breather.

Frequency Synchronization of Coupled-Oscillating Josephson Junctions

Jonathan Martin, Colgate University

Synchronization of coupled oscillators is a common phenomenon in nature. In this paper we propose to use coupled Josephson junctions to explore frequency synchronization. In order o gain a deeper insight into the mathematics of coupling dynamics, the presentation will start off with a brief treatment of the locally coupled Kuramoto model (LKM). We will apply this model to our junction array, which has been modified using Superconducting Quantum Interference devices (SQUID). This gives us the advantage to control the coupling strength by simply varying the degree of an applied external magnetic field. Furthermore, we continue to explore the origins of the bifurcation points that arise when junction switch from synchronization to de-synchronization. More specifically, we would like to outline a procedure that is able to find a relationship between the positions of these points with respect to changes in applied magnetic field.

X-Ray Diffraction of Indium Film

Natalie Mundt, SUNY Brockport

Indium film has been grown and analyzed using x-ray diffraction for many years. I will be looking at different growing techniques of the indium film on glass slides. The way each slide is cleaned prior to the growth of the indium film will influence the way the indium grows. Each slide containing the indium will be placed in a diffractometer and studied at various angles. Using the software programs Fityk and Microsoft Excel, data will be gathered and analyzed to determine key information about indium, such as grain size and structure. Cleaning the glass slides prior to growth has a definite impact on the grown indium film. This can best be seen when observing the (101) peak.

Quantized Conductance of Nano-contacts

Colby Raymond, SUNY Brockport

Light metal-to-metal-contact can show quantum effects in electronic transport. In passing from one side to the other, electrons exhibit quantum behavior. I modeled the contact bridge and the electron passing through as a particle in a box and obtain the electric charge squared divided by Planck's constant (e^2/h) as the unit of quantum conductance. I have built a circuit and using LabView data collection, I studied this surface effect in Cu-Cu, Au-Au, and In-In contacts, and report on the results.

SESSION IB. QUANTUM OPTICS AND OPTICAL TECHNIQUES

The Faraday Rotation Effect

Stephen Doud, SUNY Brockport

The phenomenon of "Faraday Rotation" is the interaction between light and a magnetic field passing through a specific medium. This experiment will consist of measuring the Faraday Effect on samples using wavelengths of 611.9 nm and 632.8 nm from a Helium-Neon laser. The light from the laser will pass through a known medium that will be acting as a polarizer once placed in a magnetic field. The light then travels through a rotating polarizer. Finally the intensity of the light at the end will be read using a photo-detector. The rotation of the polarizer will have some effect on the intensity of the light being measured. This experiment will consist of studying those effects and attempting to determine the Verdet Constant, an optical constant that describes the strength of the Faraday Effect for a material.

Lock-In Detection

Thomas Loughlin, SUNY Brockport

Lock-In (synchronous) detection is used in highly sensitive experiments within the fields of optics (blackbody radiation, Faraday rotation) as well as in electronics (resistance of metals). In such experiments, the signal of interest may be overwhelmed by inherent noise(s) of various frequencies. A Lock-In detector removes the interference such that the signal of interest may be studied. This is done by taking the inner product of sine functions of varying frequency and phase. If the sinusoids are very close in frequency, their inner product will yield a result. If the frequencies are different, the inner product will be vanishingly small. As an alternative to commercial Lock-In detectors, it is possible to build one by using an off-the-shelf integrated circuit (such as the AD-630). This circuit is capable of recovering a signal buried under noise 100,000 times larger. This detector is used to determine small resistances of metals, such as copper or indium wire and their temperature dependence.

Single-Emitter Nanocrystal Characterization and Manipulation for Room-Temperature Single Photon Source Applications

J. MacNeil, J. Winkler, D. Mihaylova, E. Shockley, and S.G. Lukishova, University of Rochester

The long-term goal of this experiment is to develop a device that is capable of emitting single photons of visible and optical communications wavelengths (1.3 or 1.55 micrometer) for quantum communication applications. To do this, confocal microscopy of various single emitters is used to select the best single photon source - nitrogen/silicon - vacancy nanodiamond and nanocrystals doped with trivalent rare-earth ions are the primary concentration for visible wavelengths, whereas PbSe quantum dots and trivalent rare-earth ions are the primary concentration for optical communications wavelengths. In addition to selecting a single emitter, confocal microscopy of plasmonic (gold nanoantennae) and photonic (2D-photonic crystals, Bragg-mirrors with defect layers) nanostructures is also performed to select the best emission enhancing nanostructure. Furthermore, the development of a precise and accurate method of placing single emitters at definite locations on the photonic/plasmonic nanostructures with an atomic force microscope is being pursued to study their fluorescence enhancement in detail.

Generation and Measurement of Two-Qubit Single-Photon States

Xinru Cheng, Colgate University

The goal of this project is to experimentally create single-photon qubits in both the spatial mode and polarization degrees of freedom, followed by measurements of their state in the position basis. We obtained single photons from photon pairs entangled in spatial mode states through parametric down-conversion. After demonstrating a robust method of generating and encoding single-qubit spatial mode states with spatial light modulators (SLMs), we encoded two-qubit states onto the single photon source. Our two-qubit states are entangled states carrying both polarization and spatial mode information. We then performed polarimetry on the single photons as a way of measuring the state. Polarimetry characterizes the polarization state at each position on the image.
Our data shows polarization of single photons varies from point to point in the position basis, a novel observation. This project is part of an ongoing effort in Prof. Galvez's lab at Colgate to create four-qubit cluster states entangled in both polarization and spatial modes. We expect our research to have applications in fields such as quantum information and quantum computing.

Development and Utilization of the Tel-X-Ometer

Ali Ropri and Dr.McColgan, Siena College

The Tel-X-Ometer will be a great addition to Siena College as it will help give students hands on experience with X-ray diffraction in classes such as X-ray spectroscopy and Modern Physics.
The research examines the Tel-X-Ometer 580 and modifying the machine to have it available for use in X-ray Spectroscopy and Modern Physics. An Arduino microcontroller is used to program and control Tel-X-Ometer, whose software is obsolete, to provide accurate and efficient X-ray diffraction results. The collection of data is improved through using the raspberry pi to store data. The data stored in the raspberry pi is easily accessible and analyzable as it displayed via computer and graphs of the data are produced using Matlab. The data collected is compared with the results provided for X-ray diffractions of NaCl and MgCl salts to verify the Tel-X-Ometer is running accurately and efficiently.

The Design and Construction of an X-ray Diffractometer
Jennifer Newcombe and Brandon Hoffman, Houghton College

X-ray diffraction is an extremely useful technique in studying crystals and thin films at an atomic level. An x-ray diffractometer is therefore in the process of being built at Houghton College to be used in experiments involving thin films. The theory behind diffraction and its use in the study of thin films and crystalline structures are examined.

SESSION II. POSTER SESSION

Proton-Induced X-Ray Emission Analysis of Crematorium Emissions
Salina F. Ali, Benjamin J. Nadarski, Alexandrea D. Safiq, Jeremy W. Smith, Josh T. Yoskowitz, Scott M. Labrake, and Michael F. Vineyard, Union College

There has been considerable concern in recent years about possible mercury emissions from crematoria. We have performed a particle-induced X-ray emission (PIXE) analysis of atmospheric aerosol samples collected on the roof of the crematorium at Vale Cemetery in Schenectady, NY, to address this concern. The samples were collected with a nine-stage cascade impactor that separates the particulate matter according to particle size. The aerosol samples were bombarded with 2.2-MeV protons from the Union College 1.1-MV Pelletron Accelerator. The emitted X-rays were detected with a silicon drift detector and the X-ray energy spectra were analyzed using GUPIX software to determine the elemental concentrations. We measured significant concentrations of sulfur, phosphorus, potassium, calcium, and iron, but essentially no mercury. The lower limit of detection for mercury in this experiment was approximately 0.2 ng/m3. We will describe the experimental procedure, discuss the PIXE analysis, and present preliminary results.

Improving Sophomore-Level Modern Physics Laboratory Equipment
Jessica Bruckner and Professor John Cummings, Siena College

The goal of this research is to update and improve the equipment used in the sophomore-level Modern Physics laboratory course at Siena College. The goal is to find the most efficient and accurate ways for students to take data. In the Blackbody Lab, I am researching the functionality and benefits of different types of thermocouple amplifiers. Another component I am incorporating in the updated models of lab equipment are Arduino boards. Arduinos are versatile, and can be adapted into the various labs. By using the modified equipment, students will be able to see a live plot of the data they are recording vs. accepted data.

Modeling the Dust Composition of Protoplanetary Disks in the Taurus Region
R. Challener, W. J. Forrest, and S. Fogerty, University of Rochester

We conducted a study of protoplanetary disks of the Taurus region using spectra from 5 to 37 microns in wavelength collected by the Spitzer Space Telescope. Spectra were extracted from the raw images using the SMART software, and then further corrected for mispointing and reddening. The dereddened spectra were then modeled as in Sargent, et al, 2009. This model fits the features of crystalline silica, forsterite and enstitite minerals, as well as amorphous pyroxene and olivine dust grains at two temperatures: a warm inner disk and a cool outer disk. Our model also takes into account the blackbody emission of the warm inner disk, cool outer disk, and the stellar photosphere. The model

determines a chi-squared value for each fit and then determines the best fit by choosing that with the lowest chi-squared. We then can see the composition of the disk based on this fit. As of now, these compositions have yet to be further investigated. When our work continues in the fall we will look more closely at how these new stars compare with those modeled in previous years.

Population Synthesis of Radio and Gamma-Ray Millisecond Pulsars

Sara Frederick, Peter Gonthier, and Alice K. Harding, University of Rochester, Hope College, and NASA Goddard Space Flight Center

In recent years, the number of known gamma-ray millisecond pulsars (MSPs) in the Galactic disk has risen substantially thanks to confirmed detections by Fermi Gamma-ray Space Telescope (Fermi). We have developed a new population synthesis of gamma-ray and radio MSPs in the galaxy which uses Markov Chain Monte Carlo techniques to explore the large and small worlds of the model parameter space and allows for comparisons of the simulated and detected MSP distributions. The simulation employs empirical radio and gamma-ray luminosity models that are dependent upon the pulsar period and period derivative with freely varying exponents. Parameters associated with the birth distributions are also free to vary. The computer code adjusts the magnitudes of the model luminosities to reproduce the number of MSPs detected by a group of ten radio surveys, thus normalizing the simulation and predicting the MSP birth rates in the Galaxy. Computing many Markov chains leads to preferred sets of model parameters that are further explored through two statistical methods. Marginalized plots define confidence regions in the model parameter space using maximum likelihood methods. A secondary set of confidence regions is determined in parallel using Kuiper statistics calculated from comparisons of cumulative distributions. These two techniques provide feedback to affirm the results and to check for consistency. Radio flux and dispersion measure constraints have been imposed on the simulated gamma-ray distributions in order to reproduce realistic detection conditions. The simulated and detected distributions agree well for both sets of radio and gamma-ray pulsar characteristics, as evidenced by our various comparisons.

Cosmic Ray Response of Megapixel LWIR Arrays from TIS (Teledyne Imaging Sensors)

Julian Girard, William Forrest, Judith Pipher, Craig McMurtry, Meghan Dorn, and Amy Mainzer, Siena College, University of Rochester, Teledyne Imaging Sensors, and NASA

Infrared detector arrays in space missions are exposed to high-energy cosmic rays that can degrade their performance. Single cosmic ray hits produce signals that can potentially confound detection of faint astronomical sources. Recently, megapixel HgCdTe LWIR (Long-Wavelength-Infrared) arrays sensitive out to 10 microns which perform well at temperatures as high as 40 K have been developed for the proposed NEOcam Discovery mission. We have characterized the response of these arrays to energetic ionizing radiation in the form of the natural muon flux in our lab in Rochester,

NY. Individual muon hits affect a number of pixels. The number of pixels affected and the magnitude of the cosmic ray signal depend on the thickness of the CdZnTe substrate. We have tested the cosmic ray response for arrays with CdZnTe thicknesses of 800, 48, and zero micron thickness. The effect of transient muon interactions with the arrays is observed as a trace of charge detected by a cluster of 1-10 pixels; the majority of energy dissipation is often centralized to one or two pixels. Arrays with intact substrates show a larger total charge within these clusters and a larger number of pixels per cluster than our substrate removed parts. The noise and dark current of pixels in these clusters are not affected by the cosmic ray event.

An Investigation of the Rayleigh Scattering of Light

Shauna LeFebvre, Union College

According to Beer's Law, the intensity of light scattered according to the Rayleigh scattering decays exponentially as measurements are taken farther away from the light source. Rayleigh scattering is the wavelength-dependent bending of light by particles up to one tenth the size of the wavelength of the light. We are investigating these properties of light using a spectroscope to measure the intensity of light from multiple, different monochromatic light sources that have been directed through a tank containing a scattering agent. We are analyzing this data by plotting the intensity of the different wavelengths versus the distance from light source. We can use the resulting graph to compare the decay rates of the different wavelengths of light. We can also determine if the scattering agents being used are bending light according to the Rayleigh Principle or not from these conclusions.

Potentials at the Limits of their Existence: Particle-Vibration Coupling in the Nuclear Many-Body Problem

Philippe Lewalle, Elena Litvinova, Filomena Nunes, and Luke Titus, Michigan State University and University of Rochester.

We consider the effects of particle-vibration coupling (PVC) in Nickel-56, both on the potential (Relativistic Mean-Field, or RMF) that models interactions between nucleons, and the energy level distribution. The theoretical approach employed uses single-particle propagators to obtain a self-energy term describing coupling between particles and phonons in the first-order perturbation theory. This self-energy is transformed into coordinate space, where it is combined with the RMF resulting in a non-local optical potential, which is then implemented to calculate nucleon-nucleus scattering.
Our work towards obtaining results comparable to scattering data is still in progress; we anticipate improvements in the agreement with data for the total potential, as compared with the RMF alone. Additionally, we continue previous work done with this formalism on energy level distributions by examining the contributions of individual vibrational (phonon) modes to level fragmentation. Analyses of the relative strengths of the fragments in highly-fragmented states through their spectroscopic factors demonstrate that in many cases, only a few phonon modes cause large amounts of fragmentation, but

that the others may alter the relative strengths of the fragments caused by those few modes.

Analyzing the effect of the Four Factors of Basketball Success on Offensive Efficiency

Daniel Loman and Matthew Bellis, Siena College

In trying to quantify how basketball teams win games, Dean Oliver ("Basketball on Paper") formulated his "Four Factors of Basketball Success". These factors include shooting, turnovers, rebounding, and free throws, and collectively contribute to a team's offensive efficiency. While interesting, these statistics do not reveal how a team should maximize its offensive efficiency, and pundits disagree on their individual importance. We use a variety of statistical techniques to examine the importance of these four factors as they apply to NBA teams, and create more accurate estimates of their individual weight. The results of this research could provide greater insight to fans and analysts in discovering how teams score.

A Study of Weak Magnetic Focusing

Sylvia Morrow and Mark Yuly, Houghton College

The small cyclotron at Houghton College loses at least 80% of the beam due to collisions with the dees and chamber walls. Weak magnetic focusing is being studied as a technique to reduce this problem by altering the magnetic field, which is currently nearly uniform, to create a greater radial magnetic field component that will create a restoring force to return ions to the central orbit plane. A computer model of the magnet and chamber is being developed to design magnet shims that will give the most advantageous magnetic field shape for good focusing. A two dimensional cross section of the magnet has been modeled using Poisson Superfish, the results of which were used to track ions with the Simion 8.0 code. The model can be used to simulate various options for shim sizes and configurations the results of which will determine which shims will eventually be tested. Results of the computer model were compared with analytical results using a simplified model.

Examining the Relationship Between Period vs. Diameter of Asteroids

Nicholas Powers and Anthony Smith, SUNY Oswego and National University of Taiwan

The Palomar Transient Factory (PTF) is an astronomy project located at CalTech in California that is centered around the P48 telescope. The data collected consists of both numerical catalogs and images. The collected data can be used to detect non-static objects such as asteroids. After this distinction was made, light curve data was used to examine the relationship between the period and diameter of asteroids. This analysis can be used to determine whether or not certain previously observed trends relating asteroid size to its possible period of rotation were inherent properties of all asteroids.

The Coincidence Efficiency of Sodium Iodide Detectors for Positron Annihilation
Thomas Eckert and Mark Yuly, Houghton College

One possible diagnostic technique for characterizing inertial confinement fusion reactions involves tertiary neutron activation of ^{12}C via the $^{12}C(n,2n)^{11}C$ reaction. Because the cross section for this reaction is not well measured in the energy range of interest, a new measurement was recently made at Ohio University. Part of this experiment involves counting the positron annihilation 511 keV gamma rays from the ^{11}C decay using sodium iodide detectors in coincidence. A new technique has been developed to measure this coincidence efficiency by detecting the positron prior to its annihilation, and vetoing events in which decay gamma rays other than the 511-keV gamma ray could enter the detectors.

Development of Synchronous Direct Digital Receiver System for Geospace Imaging Studies
Chan Tran, Meghan Harrington, Joe Kujawski, and Allan T. Weatherwax, Siena College

Beautiful auroral displays results from precipitating electrons ionizing nitrogen and oxygen in the polar upper atmosphere. The enhanced ionization can affect the propagation of HF radio communication signals and reduce the cosmic radio noise emission from the Milky Way Galaxy that passes through the atmosphere. The riometer (relative ionospheric opacity meter) measures the ionization effects, and together with optical cameras, can be used to infer characteristics of the energetic particles. Changes in the aurora can be observed by using riometers in order to quantify electromagnetic waves around the range of 20-50 MHz. This presentation will focus on preliminary results relating to the design, testing, and building a novel synchronous direct digital receiver that will form the foundation of the next-generation riometer. With this system, riometers will digitize the signals from the antennas, making data collection easier to analyze and provide increased temporal and spatial resolution. The eventual goal is to develop a network of imaging riometers in Canada to provide a fundamentally new view on key geospace processes, targeting specifically high-energy electrons.

Energy-Dispersive X-Ray Fluorescence for Heavy Metal Quantification on Soil Products
Nguyen Truong, Dr. Zewu Chen, Jon Dunphy, and Dr. Michele McColgan, Siena College and X-Ray Optical Systems

Discovering the composition of soil is difficult due to the challenge of analyzing each non-homogeneous particle found in the sample region. However, this analysis may have significant agricultural benefits, such as understanding the soil's concentrations prior to using it for growing crops. Through the use of Energy-Dispersive X-Ray Fluorescence, it becomes nearly impossible to obtain consistent results due to the lack of a homogeneous sample. The implementation of a rotation stage allows for the analysis of an entire section to produce an accurate, yet consistent data set for determining the composition of soil.

With reliable measurements, X-Ray Fluorescence is a valuable means of quantifying the properties of soil products.

Methods for Dispersing Long Single-Walled Carbon Nanotubes

Jaime C. Vela, Amanda Amori, and Todd Krauss, University of Rochester

A series of experiments were performed in order to investigate a variety of methods for dispersing long single-walled carbon nanotubes (SWNTs) in aqueous and non-aqueous solutions using magnetic stirring and bath sonication. In doing so, harsh chemical and mechanical processing methods that are known to damage SWNTs were avoided. By using more gentle processing methods, the pristine SWNTs are preserved and longer tube lengths are achieved. Using wide-field microscopy to image the individualized SWNTs, measurements of the length of tubes are made and average nanotube lengths per processed sample are computed.

Star Formation in the NGC 5846 Group of Galaxies

Lucas Viani, Union College

Environmental interactions in clusters of galaxies are known to alter the evolution of member galaxies, but does the environment play a significant role in lower density galaxy groups? In this research, star formation properties of galaxies in the NGC 5846 group were determined by reducing and analyzing narrowband H-alpha and broadband R images obtained at the 0.9m telescopes at Kitt Peak National and Cerro Tololo Inter-American Observatories. Additionally, neutral hydrogen data from the Arecibo Legacy Fast ALFA survey were used to measure the cold neutral gas content, which provides the raw material for star formation. The amounts and extents of the star formation in sample galaxies were analyzed as a function of cold gas content, galaxy type, and position in the group and compared to those of galaxies located in other environments. The typical star formation rates and extents of NGC 5846 galaxies are less than those of isolated galaxies and similar to those of galaxies located in the Virgo Cluster and other group environments. Truncated star formation, similar to that of galaxies in the Virgo cluster, is seen in several NGC 5846 galaxies. Thus the environment has played a role in prematurely halting star formation in this group.

Robotics Beacon for Robot Positioning with Simulink

Katherine Robinson, Siena College

Positioning systems are an ever improving and changing field. These systems have become more and more prevalent and need for accuracy is greater than ever. This positioning system is a robot-beacon system designed so that signals are given off by beacons and received by the robot. Utilizing an Arduino microprocessor, an encoded signal is transmitted by the Arduino. Simulink, a Mathworks package, is used to encode the signal and transmit the signal using the Arduino digital pins and an analog to digital convertor. The use of an Arduino makes this technology significantly less expensive. The robot uses multiple beacons with individual signals and different locations to figure out where it is, and how it needs to move. The location is pin pointed using trilateration, a technique of overlaying locations and radial distances to narrow down possible locations. This process will result in measurements projected within three cm accuracy. This will be applicable to many different areas including globalization, robotics and agriculture.

SESSION IIIA. HIGH-ENERGY AND NUCLEAR PHYSICS

Opportunistic High Energy Physics Computing in User Space with Parrot

Dillon Skeehan, Paul Brenner, Ben Tovar, Douglas Thain, N. Vallis, A. Woodard, M. Wolf, T. Pearson, S. Lynch, and K. Lannon, University of Rochester and University of Notre Dame

In this presentation, we give a general method for software and data access for opportunistic grid systems to aid in the analysis of high-energy physics through the Compact Muon Solenoid (CMS) experiment at CERN. Due to the high throughput of data generated by the CMS experiment, current computational resource capabilities owned by CERN and associated institutions through the Worldwide LHC Computing Grid (WLCG) are incapable of keeping pace with analysis. This problem is expected to worsen as the LHC undergoes upgrades in the following years increasing the rate and complexity of collisions. In order to combat this growing concern, CERN has broadened its scope to employ opportunistic methods of computation for periods of high intensity data analysis. The computational method explored in this poster relate to CMS data analysis on opportunistic computational grids such as the Center for Research Computing High Performance Computing facility at Notre Dame. We show how CMS software and data may be accessed through the Parrot Virtual File System, a tool for accessing remote file systems, to allow for submission of jobs to grids with no previous connection to the CMS experiment. We then give an analysis of the eviction of these jobs and provide a comparison of performance between this new approach and traditional dedicated resources.

Reconstructing Energy of Large Angle Muons in Neutrino Quasielastic Scattering Events

A. Bodek, R. Sims, M.E. Christy, and T. Walton, University of Rochester and Hampton University

The reconstruction of quasielastic events relies on high precision measurements of muon momenta. For non-magnetized neutrino detectors such as MINERvA, downstream muon spectrometers are used for this measurement. Only low Q2 events produce muons with angles small enough to be accepted in these downstream spectrometers. As a result, high Q2 events will not be reconstructed. We show that in these high Q2 quasielastic neutrino events, the muon momentum can be reconstructed using only the angles of the final state nucleon and muon. Similarly, the momentum of the final state nucleon and the incoming neutrino energy can also be reconstructed.

A Measurement of the $^{12}C(n,2n)^{11}C$ Cross-Section for use as an Inertial Confinement Fusion Diagnostic

Garrett Hartshaw and Mark Yuly, Houghton College

In inertial confinement fusion (ICF), nuclear fusion reactions are initiated by bombarding a small fuel pellet with high power lasers. One ICF diagnostic involves measuring the high-energy neutron yield via activation of ^{12}C, requiring an accurate value for the $^{12}C(n,2n)^{11}C$ cross-section. An experiment to determine this cross-section in the energy range of 20-27 MeV was performed on the tandem van de Graaff accelerator at Ohio University. Monoenergetic neutrons, produced via the T(d,n)α reaction, were allowed to strike targets of polyethylene and graphite. Target activation was determined by counting positron annihilations due to β+ decay using back-to-back NaI detectors and the neutron flux was determined indirectly via protons scattered from the polyethylene. The cross-section can be determined from the number of ^{11}C present in the target after activation, the number of protons detected during activation, and the geometry of the experiment.
Funded in part by a LLE contract through the DOE.

Construction and Characterization of a Farnsworth-Hirsch Fusor

Ian Love and Mark Yuly, Houghton College

A table-top Inertial Electrostatic Confinement (IEC) Fusion device was constructed at Houghton College to explore the properties of plasmas and the nuclear reactions that may be induced in this device. A spherical stainless steel wire grid 7.0 cm in diameter mounted centrally in the cylindrical 0.3 m diameter vacuum vessel was raised to nearly 30 kV. A grounded spherical wire grid 20.3 cm in diameter surrounded the charged sphere. An air-cooled oil diffusion pump and a mechanical forepump evacuated the chamber to approximately 10^{-6} torr. An ion source gas was leaked into the chamber raising the pressure to 1×10^{-4} - 1×10^{-3} torr. The voltage across the inner grid, the current through the high voltage circuit, the chamber pressure, and the x-ray radiation were measured over the course of the experiment.

SESSION IIIB. ASTRONOMY

Observations of the Eclipsing Binary U Cephei using the SUNY Cobleskill Remote Observatory

Ronnie Rera & Edward Stander, Siena College and SUNY Cobleskill

Eclipsing binary star systems consist of two stars orbiting one another that produce an eclipse when viewed from earth. These systems are important because the orbital period and velocity can be used to determine the radii and masses of the stars, enabling a crucial test of theories of stellar evolution. Using the newly commissioned SUNY Cobleskill remote observatory, we obtained time-resolved photometry of the well-known U Cephei eclipsing binary star system. The U Cephei light curve shows wide variations due to the fact that mass is being transferred from the secondary to the primary. We conclude with a discussion of how the SUNY Cobleskill observatory will enable undergraduate students to undertake a wide range of observational astronomy projects.

Quasar Variability Measurements in Hubble Space Telescope Archive Data

Robert Chancia, SUNY Brockport

The purpose of this research project is to search for variability in quasar emission lines (specifically Lyα and CIV) using data from the Hubble Space Telescope (HST) archive. For a sample of over 1,000 bright quasars I will be searching for changes in the spectra obtained by multiple generations of spectrographs over time periods of hours, months, or years. This information will be a useful input to models of quasar activity.

A Study of Ultra-Long-Period Cepheids

Brittany Barrett, Scott Lucchini, David ONeill, C. Ngeow, and Prof. S. Kanbur, SUNY Oswego

Ultra-Long Period Cepheids (ULPC) are Cepheids with periods longer than 80 days. Because of their extreme brightness, they have an important role to play in the Cepheid extra-galactic distance scale. This in turn is vital in order to obtain a CMB independent estimate of Hubble's constant accurate to less than a few percent. Here we compile recent observations of ULPCs from the literature and study the structure of their light curves through Fourier decomposition. We compare this structure with classical Cepheids and the longer period Miras and discuss similarities and differences. We also consider the PL relation of ULPC's in relation to the standard Cepheid PL relation. We close with a discussion of future work.

Principle Component Analysis of Cepheid Variable Stars

Daniel Wysocki, Zachariah Schrecengost, Earl Bellinger, Shashi Kanbur, Sukanta Deb, and Harinder P. Singh, SUNY Oswego

We use Principle Component Analysis (PCA) and Fourier decomposition on LMC and SMC cepheids observed by OGLE III to find relationships between a cepheid's period, luminosity, and light curve structure. Unlike the Period-Luminosity and Period-Luminosity-Color relations, these are independent of extinction. We consider their advantages and disadvantages in estimating distances.

SESSION IVA. BIOLOGICAL PHYSICS

Bifurcations in the Synchronization States of Entorhinal Cortex Layer II Stellate Cells

Anna Miettinen, Colgate University

Neural networks exhibit extremely complex behaviors on a large scale, but we are able to study their synchronization and general behavior in a much smaller system. This research explores the synchronization and bifurcations in the phase plots of 2 coupled stellate cell neuron models. Analyzing the conditions under which stability regions break down and become chaotic will be important to developing a better understanding about how strongly coupled neurons interact and synchronize. The synchronization of large numbers of neurons may be responsible for our perception and thought, conscious or unconscious. I plan to investigate the bifurcation plots while varying the synaptic coupling strength in the Hodgkin and Huxley-derived Acker neuron model. The synaptic coupling strength between strongly coupled neurons has been shown to cause deviations in linearly-predicted models of synchronization behavior.

The Effect of Ion Channel Noise on Synchronization of Entorhinal Stellate Cells

Mary Rose Devine and Patrick Crotty, Colgate University

Theta-frequency oscillations (8-12 Hz) in large groups of entorhinal cortex grid cells and hippocampal place cells have recently received special attention due to role they apparently have in encoding information about position. We use a biologically realistic computational model of two or three synaptically coupled entorhinal cortex stellate cells [1] to investigate synchronization properties of these networks of neurons. In a previous study [2], we found that if the intrinsic firing frequencies of the computational neurons are near the theta range, then they generally synchronize their oscillations much more quickly than at significantly either higher or lower ranges. However, our model looked only at identical neurons and lacks some biologically relevant considerations. Here, these results are further studied by including biologically realistic channel noise [3] in the computational model. Our results concern both the effect on firing properties for each neuron individually, and on the synchronization time and strength for coupled neurons as a network. We found that channel noise could either increase or decrease the time for coupled stellate cells to synchronize by a significant amount, depending on which channel the noise was applied to. We also found that the synchronization time appears to be largely independent of the underlying cell parameters that determine the intrinsic frequencies (the persistent sodium and hyperpolarization-activated cation conductances) and depend only on the frequencies themselves, potentially simplifying the process of parameter sweeps.

1. Acker CD, Kopell N, White JA: Synchronization of strongly coupled neurons: relating network behavior to biophysics. J Comput Neurosci 2003, 15:71-90.
2. Crotty P, Lasker E, Cheng S: Constraints on the synchronization of entorhinal cortex stellate cells. Phys Rev E 2012, 86:011908.

3. Linaro D, Storace M, Giugliano M (2011) Accurate and Fast Simulation of Channel Noise in Conductance-Based Model Neurons by Diffusion Approximation. PLoS Comput Biol 7(3): e1001102. doi: 10.1371/journal.pcbi.1001102

Synchronization of non-identical entorhinal cortex stellate cells

Betty Anderson, Colgate University

The synchronization of large numbers of neurons in mammalian brains has been observed many times. Although it is not completely known how, it is thought that this synchronization is important for many cognitive functions. The entorhinal cortex in the hippocampus is believed to be the hub for storing and accessing memory. Little is known about memory storage and recall, but understanding more about neuronal synchronization will increasing our understanding.

We used computational models based on experimental data to simulate non-identical entorhinal cortex layer II stellate cells set in three two-neuron excitatory, inhibitory or mixed networks. For each network, we simulated the time to reach a steady state from an initially random phase configuration for neurons within a region in conductance parameter space. The maximum persistent sodium conductance and maximum hyperpolarization-activated cation current conductance values determine the intrinsic firing frequency so the coupled neurons do not always have identical frequencies. We found that neurons with similar firing frequencies became highly synchronized with each other. A synchronization peak was observed at an average frequency of 19 Hz. In networks of neurons with non-similar firing frequencies, the synchronization was determined by the average frequency of the neurons.

SESSION IVB. EXPERIMENTAL TECHNIQUES

Radar Cross Section from a Dielectric Sphere Small Satellite

Cadet Tyler Rauenzahn and LTC Sam Amber (Advisor)
US Military Academy and MIT Lincoln Laboratory

United States missile defense and space surveillance ground radars require orbital targets to assist in atmospheric and electromechanical effects calibration. Hollow spherical targets composed of dielectric powder can concentrate reflected radar energy and provide an enhanced radar cross section (RCS), thereby presenting an opportunity to conduct the orbital radar target mission from a passive, low-cost small satellite. Previous research focused on dielectric material selection and powder packing fraction design. Current research developed 15 and 30 cm diameter thermoplastic spherical shells packed with 35 micron alumina powder grains to meet a 5 dBsm RCS requirement across the 3-35 GHz frequency range. The small satellite design was completed using 3-D printed Acrylonitrile Butadiene Styrene (ABS) sphere caps that included the Experiment Attachment Fixture for the International Space Station's small satellite deployment system. Follow-on developmental testing will focus on thermal-vacuum, launch dynamic loading, and laser retroreflectivity of potential outer surface coatings.

Black Body Spectrometer

Jonathan Delehanty, SUNY Brockport

With a hand built prism-based spectrometer using off-the-shelf equipment and parts I plan to experimentally obtain the continuous black body spectrum from an incandescent light bulb. Further, the goal is to determine the wavelength at which intensity peaks and use Wien's Law to determine the temperature of the tungsten filament of the light bulb. This will then be compared to the resistance method of determining temperature of the filament through Ohm's Law and four contacts. This will allow for the comparison of remote measurement and direct measurement of temperature; thereby showing the correctness and accuracy of the remote method.

The Design and Construction of an Atomic Force Microscope

Ethan Ocock and Brandon Hoffman, Houghton College

A variable temperature atomic force microscope (AFM) is being built at Houghton. The AFM will use a spring vibration isolation system with eddy current dampening in order to remove mechanical vibrations from both the machine and external sources. To approach and scan a sample, a modified "Johnny Walker" beetle will be built to move up, down, and across a ramp. Once complete and fully operational, this AFM will be able to scan sample surfaces with a resolution of nanometers, making it useful for many fields of science.

Inexpensive Ultrasonic Interferometer for measuring changes of the speed of sound in materials

John Grossmann, Colgate University

Ultrasonic pulse-echo interference is a technique that can be used to complement neutron scattering for measuring and detecting shifts in lattice symmetry as well as changes in material properties in the limit of low energy phonons. This is done by calculating the relative change in the speed of sound through a material and exploiting the relationship between the speed of sound, and elastic stiffness through the system of Christoffel equations. We designed and built an ultrasonic interferometer for the purpose of an inexpensive method to perform such measurements. Our data indicate that, by making all of the apparatus components instead of purchasing, we achieve similar precision in the relative change in speed of sound as well as significantly decreasing apparatus cost.

Angular momentum transfer to strongly trapped absorptive particles via LG modes

Michael Senatore and Professor Catherine Herne, Colgate University

Micro-rotors are integral components of micro-machines with moving parts. One method of driving these rotors is to use light, specifically Laguerre-Gauss (LG) beams, to provide the angular momentum. We have shown that rotational systems can indeed be produced out of absorptive materials. This in our case is demonstrated with graphite being manipulated under an LG mode. In addition to this, we use refractive silica spheres to help trap graphite pieces in place. The presence of the refractive particles provides a gradient force that produces a much stronger, more stable trap and allows for a higher variability in values of the azimuthal mode (ℓ). Angular momentum is hereby provided to both the silica and the graphite to bring about direct rotation of the absorptive graphite. Essentially, a piece of graphite with silica spheres adhered to it is put under the influence of a focused LG mode. This mass experiences both a trapping force and an angular force, resulting in trapped rotating graphite and silica. Using this method, we can also measure a number of different attributes of the system including adhesion of the materials, rotational force, and indirect trapping force.

LIST OF PARTICIPANTS

Name		Affiliation
Salina Ali	Undergraduate Student	Union college
Sam Amber	Faculty	US Military Academy
Betty Anderson	Undergraduate Student	Colgate University
Brittany Barrett	Undergraduate Student	SUNY Oswego
Sean Bentley	Faculty	Adelphi University
Jessica Bruckner	Undergraduate Student	Siena College
Brennen Campbell	Undergraduate Student	Houghton College
Charles Carrillo	Undergraduate Student	Siena College
Brian Cattafe	Undergraduate Student	Union College
Ryan Challener	Undergraduate Student	University of Rochester
Robert Chancia	Undergraduate Student	SUNY Brockport
Xinru Cheng	Undergraduate Student	Colgate University
Nicholas Cothard	Undergraduate Student	University of Rochester
Kyle Craft	Undergraduate Student	Houghton College
Luke Cybulski	Undergraduate Student	University of Rochester
Sean Daigler	Undergraduate Student	Houghton College
Jonathan Delehanty	Undergraduate Student	SUNY Brockport
Mary Rose Devine	Undergraduate Student	Colgate University
Tony DiMino	Undergraduate Student	University of Rochester
Stephen Doud	Undergraduate Student	SUNY Brockport
Thomas Eckert	Undergraduate Student	Houghton College
Jon Farrell	Undergraduate Student	Siena College
Victoria Finch	Undergraduate Student	Houghton College
Kyle Flemington	Undergraduate Student	Houghton College
Janet Fogg	Staff	University of Rochester
William Forrest	Faculty	University of Rochester
Sara Frederick	Undergraduate Student	University of Rochester
Julian Girard	Undergraduate Student	Siena College
Alyx Gleason	Undergraduate Student	Siena College
Harrisonn Griffin	Undergraduate Student	Union College
Garrett Hartshaw	Undergraduate Student	Houghton College
Brandon Hoffman	Faculty	Houghton College
Chelsea Jean	Undergraduate Student	University of Rochester
Shashi Kanbur	Faculty	SUNY Oswego
Md Tanveer Karim	Undergraduate Student	University of Rochester

Name		**Affiliation**
Margaret Kirkland	Undergraduate Student	Houghton College
David Knapick	Undergraduate Student	Siena College
Paul Lashomb	Undergraduate Student	Houghton College
Shauna LeFebvre	Undergraduate Student	Union College
Philippe Lewalle	Undergraduate Student	University of Rochester
Daniel Loman	Undergraduate Student	Siena College
Orlando Lopez	Undergraduate Student	St. John's University
Thomas Loughlin	Undergraduate Student	SUNY Brockport
Ian Love	Undergraduate Student	Houghton College
James MacNeil	Undergraduate Student	University of Rochester
Miranda Marnes	Undergraduate Student	Siena College
Jonathan Martin	Undergraduate Student	Colgate University
Anna Miettinen	Undergraduate Student	Colgate University
Eric Monier	Faculty	SUNY Brockport
Emily Morrow	Undergraduate Student	Houghton College
Sylvia Morrow	Undergraduate Student	Houghton College
John Moustakas	Faculty	Siena College
Natalie Mundt	Undergraduate Student	SUNY Brockport
Jennifer Newcombe	Undergraduate Student	Houghton College
Ethan Ocock	Undergraduate Student	Houghton College
Annmarie Pryor	Undergraduate Student	Siena College
Tyler Rauenzahn	Undergraduate Student	US Military Academy
Colby Raymond	Undergraduate Student	SUNY Brockport
Ronnie Rera	Undergraduate Student	Siena College
Katherine Robinson	Undergraduate Student	Siena College
Ali Ropri	Undergraduate Student	Siena College
Adriana Saldan	Undergraduate Student	University of Rochester
Daniel Schussheim	Undergraduate Student	Colgate University
Michael Senatore	Undergraduate Student	Colgate University
Robert Sims	Undergraduate Student	University of Rochester
Dillon Skeehan	Undergraduate Student	University of Rochester
Anthony Smith	Undergraduate Student	SUNY Oswego
Ivory Stokes	Staff	University of Rochester
Mohammed Z. Tahar	Faculty	SUNY Brockport
Jack Teitel	Undergraduate Student	University of Rochester
Chan Tran	Undergraduate Student	Siena College
Nguyen Truong	Undergraduate Student	Siena College

Name		**Affiliation**
Ashley Tucker	Undergraduate Student	St. John's University
Jaime Vela	Undergraduate Student	University of Rochester
Graziano Vernizzi	Faculty	Siena College
Lucas Viani	Undergraduate Student	Union College
Liza Villanueva	Undergraduate Student	Siena College
Laurel Vincett	Undergraduate Student	Houghton College
Alex Warn	Undergraduate Student	Siena College
Michael Warrener	Undergraduate Student	Union College
Frank Wolfs	Faculty	University of Rochester
Daniel Wysocki	Undergraduate Student	SUNY Oswego
Jun Yin	Undergraduate Student	University of Rochester
Jonathon Yuly	Undergraduate Student	Houghton College
Mark Yuly	Faculty	Houghton College
Yanci Zhang	Undergraduate Student	Union College
Dale Zych	Faculty	SUNY Oswego

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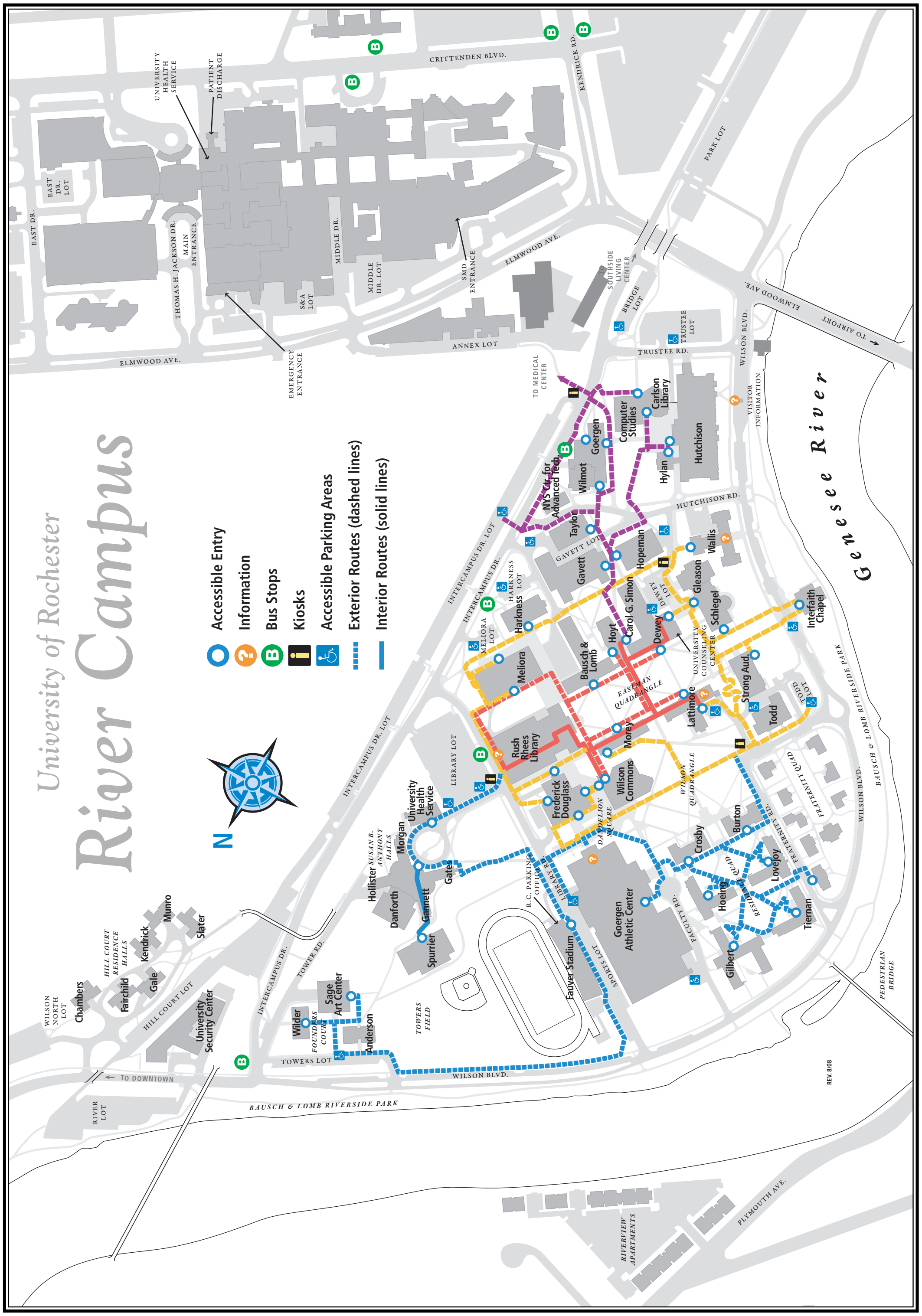
WHERE IS LUNCH?

BUILDING 48, DANFORTH DINING HALL.


University of Rochester
River Campus
Accessible Entry
Information
Bus Stops
Kiosks
Accessible Parking Areas
Exterior Routes (dashed lines)
Interior Routes (solid lines)
N
Genesee River
CRITTENDEN BLVD.
KENDRICK RD.
ELMWOOD AVE.
EAST DR.
MIDDLE DR.
INTERCAMPUS DR.
WILSON BLVD.
HUTCHISON RD.
TRUSTEE RD.
FACULTY RD.
FRATERNITY RD.
BAUSCH & LOMB RIVERSIDE PARK
PLYMOUTH AVE.
TO DOWNTOWN
TO AIRPORT
PARK LOT
ANNEX LOT
LIBRARY LOT
TOWERS LOT
RIVER LOT
HILL COURT LOT
TOWERS FIELD
EASTMAN QUADRANGLE
WILSON QUADRANGLE
DANDELION SQUARE
FRATERNITY QUAD
PEDESTRIAN BRIDGE
RIVERVIEW APARTMENTS
VISITOR INFORMATION
Carlson Library
Computer Studies
Hutchison
Hylan
Goergen
Wilmot
Taylor
Gavett
Hopeman
Wallis
Gleason
Schlegel
Interfaith Chapel
Harkness
Meliora
Bausch & Lomb
Hoyt
Carol G. Simon
Dewey
Lattimore
Strong Aud.
Todd
Rush Rhees Library
Morey
Wilson Commons
Frederick Douglass
University Health Service
Morgan
Hollister
Danforth
Gates
Gannett
Spurrier
Fauver Stadium
Goergen Athletic Center
Crosby
Burton
Lovejoy
Hoeing
Tiernan
Gilbert
Chambers
Fairchild
Gale
Kendrick
Munro
Slater
University Security Center
Wilder
Sage Art Center
Anderson
REV. 8/08