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:

Rochester, April 5, 2014

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, ÒThe eternal mystery of the world is its comprehensibility.Ó

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

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

XXXIII ÐROCHESTER SYMPOSUM FOR PHYSICS (ASTRONOMY AND OPTICS) STUDENTS
SPS ZONE 2 REGIONAL MEETING

PROGRAM

8:15 AM Ð 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 Ð 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 Nanocontacts
Colby Raymond, SUNY Brockport

9:00 AM Ð 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

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

11:00 AM – 12:00 PM: SESSION III

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 Grossman, 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 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 Saddiqi, 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 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 seeded and unseeded samples is also studied and discussed.

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 desynchronization. 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 Nanocontacts

Colby Raymond, SUNY Brockport

Light metal-to-metal nanocontact 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 PlanckÕs 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-

SESSION IB. QUANTUM OPTICS AND OPTICAL TECHNIQUES

The Faraday Rotation Effect

Stephen Doud, SUNY Brockport

The phenomenon of ÒFaraday RotationÓ 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 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 more mundane topics (resistance of metals). In such experiments, the signal of interest may be overwhelmed by inherent noise(s) of various frequencies. A Lock-

rare-earth ions are the primary concentration for optical communications wavelengths. In

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 the 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 is 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-

determines a chi

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 ~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

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 (ÒBasketball on PaperÓ) formulated his Four Factors of Basketball SuccessÓ These factors include shooting, turnovers, rebounding, and free throws, and collectively contribute to a teamÕs 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 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 in 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 and distinguish 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 othe

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 intrinsic 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 2.32 cm BT 24 0 0 0.ba2 (xri) 0.2 .pad ga ddit

convertor. The use of an Arduino makes this technology significantly less expensive. The robot uses multiple beacons with individual signal 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 III A. HIGH-ENERGY AND NUCLEAR PHYSICS

Opportunistic High Energy Physics Computing in User Space with Parrot

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) 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 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 10^{-4} - 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.

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 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 greater 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 (4-12 Hz) in large groups of entorhinal cortex grid cells and

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

SESSION IVB. EXPERIMENTAL TECHNIQ UES

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		

Name	Affiliation
Margaret Kirkland	Undergraduate Student

Name		Affiliation
Ashley Tucker	Undergraduate Student	St. John's University
Jaime Vela	Undergraduate Student	University of Rochester
Graziano Vernizzi	Faculty	Siena College

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WHERE IS LUNCH?

BUILDING 48, DANFORT