Rochester, April 6, 2013

Dear Participants:

Welcome to the 32nd 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/2013/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 Abstrass.

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
Aprelev, Pavel	LOBBY	10:00

NAME	LOCATION	TIME

NAME	LOCATION	TIME
van Dyne, Aaron	LOBBY	10:00
van Dyne, Aaron	B&L 106	14:00
Verde, Justin	LOBBY	10:00

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

PROGRAM

8:00 AM – 8:30 AM: REGISTRATION AND POSTER SETUP (B&L LOBBY)

8:30 AM: WELCOME (B&L 109)

Prof. Frank Wolfs, University of Rochester.

8:45 AM – 10:00 AM: SESSION IA. OPTICS, QUANTUM OPTICS, AND QUANTUM MECHANICS (B&L 109)

SESSION CHAIR: PROF. JOSEPH EBERLY, UNIVERSITY OF ROCHESTER

8:45 Polarization of Iridescent Shells
Carrie Burgess, Colgate University

9:00 Spatial Mode Encoding of Photons Using Spatial Light Modulators
Xinru Cheng, Colgate University

9:15 Using a Spatial Light Modulator to Create Poincare Laser Beam Patterns
Brett L. Rojec, Colgate University

9:30 Frequency-Stabilized External-Cavity Diode Lasers for an Undergraduate Teaching Laboratory Magneto-optical Trap
Peter Heuer, Maitreyi Jayaseelan, Justin T. Schultz, Marek Haruza, Azure Hansen, and Nicholas P. Bigelow, University of Rochester

9:45 Oscillations in Classical and Quantum Mechanics
Philippe Lewalle, Shantanu Agarwal, and Prof. Joseph Eberly, University of Rochester

8:45 AM – 10:00 AM: SESSION IB. INSTRUMENTATION (B&L 106)

SESSION CHAIR: PROF. MARK YULY, HOUGHTON COLLEGE

8:45 Refurbishment of the Houghton College Scanning Transmission Electron Microscope (STEM)
Mark Spencer and Brandon Hoffman, Department of Physics, Houghton College

9:00 Designing the Trigger Monitor for the LUX Dark Matter Detector
Brian Degner, Eryk Druszkiewicz, and Frank Wolfs, University of Rochester

9:15 Exploring the Capabilities of the Houghton College Cyclotron
Nicholas Fuller, Sylvia Morrow, and Mark Yuly, Department of Physics, Houghton College

9:30 Low activity Mössbauer Sources for Undergraduate Labs
Keith Mann, Emily Morrow, and Mark Yuly, Department of Physics, Houghton College

Measuring the Cross Section for the $^{12}C(n, 2n)^{11}C$ Reaction in the 20-30 MeV Energy Interval

Garrett Hartshaw, Keith Mann, Tyler Reynolds and Mark Yuly, Stephen Padalino, Danae Polsin, Megan Russ, Michael Krieger, Collin Stillman, Angela Simone, Mollie Bienstock, and Drew Ellison, and Craig Sangster, Houghton College, SUNY Geneseo, and the Laboratory for Laser Energetics, University of Rochester

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10:30 AM – 11:30 AM: SESSION IIIA. BIOLOGICAL AND MEDICAL PHYSICS (B&L 109)

SESSION CHAIR: PROF. SAMUEL AMBER, UNITED STATES MILITARY ACADEMY, WEST POINT

10:30 Establishing institution-specific action levels for EPID-based QA for IMRT at the URMC
A Saldan, D Rosenzweig, A Gray, R Meiler, D Clark, R Abu-Aita, M Schell, and D Cavanaugh, University of Rochester

10:45 Hole Transport in DNA: Part I
Alexander J. Breindel, Rachel E. Stuart, William J. Bock, David N. Stetler, Shane M. Kravec, and Esther M. Conwell, University of Rochester

11:00 Hole Transport in DNA: Part II
Alexander J. Breindel, Rachel E. Stuart, William J. Bock, David N. Stelter, Shane M. Kravec, and Esther M. Conwell, University of Rochester

11:15 Simulating Dynamics of Coupled Josephson Junction Neurons
Siyang Guo, Colgate University

10:30 AM – 11:30 AM: SESSION IIIB. CONDENSED MATTER AND SOLID STATE PHYSICS I (B&L 106)

SESSION CHAIR: PROF. BRANDON HOFFMAN, HOUGHTON COLLEGE

10:30 Frequency Synchronization and Non-Linear Dynamics in Josephson Junction Arrays
Matthew Brunetti, Colgate University

10:45 Fluxon Tunneling in Josephson Junction Arrays
Ryan Freeman, Colgate University

11:00 Rate constants of lithium molecules
Colleen Kelleher, Siena College

11:15 Magnetic Susceptibility Measurements
Kyle Conine, SUNY Brockport

11:30 AM

1:30 PM – 2:30 PM: SESSION IV

1:30 PM – 2:15 PM: SESSION IVC. CONDENSED MATTER AND SOLID STATE PHYSICS II (B&L 407)

SESSION CHAIR: PROF. MOHAMMED TAHAR, SUNY BROCKPORT

1:30 An Evaporation Deposition System for the In-Situ Study of Thin Metal Films
Joshua Mertzlufft and Brandon Hoffman, Department of Physics, Houghton College

1:45 The Design and Construction of an Interferometer System for the Study of Thin Metal Films
Tyler Reynolds and Brandon Hoffman, Department of Physics, Houghton College

2:00 Vacuum Deposition and Characterization of Thin Indium Films
Jeremy Mehta, SUNY Brockport

SESSION IB. INSTRUMENTATION

REFURBISHMENT OF THE HOUGHTON COLLEGE SCANNING

SESSION II. POSTER SESSION

CONSTRUCTION OF AN OPTICAL TWEEZER APPARATUS

Pavel Aprelev and Chad Orzel
Union College

Optical tweezers can be used to trap micron-scale particles in a focused laser beam and move those particles within the sample by either moving the beam or the stage. When the light is focused in a point it creates forces on dielectric objects that point towards the focal point. The magnitude and the span of the force are dependent on the size of the focal point of the beam, generally around 1 m. We used a fiber-coupled 2-watt infrared laser as the source of light. By controlling the position of the focal point of the beam relative to the stage, we are able to pick up 1 m plastic beads and move them around in 3D, using an electrically controlled stage. Using a LabVIEW program, we were able to move the stage at precise speeds and thus determine the forces within the focal point of the beam.

MEASURING THE INCIDENCE OF LIRGS AMONG BLUE EDISCS CLUSTER GALAXIES

Alissa Earle and Dr. Rose Finn
Siena College

Galaxies can be broadly grouped into two categories: red galaxies that don't form many new stars, and blue galaxies that are still converting gas into stars. What causes a galaxy to evolve from blue to red? One hypo BT 50 0 0 50 0 0 Tm /TT12-0.2 (E ED) -0.2 (I) -0.2 (S) q0.24 0 4n

manipulation of magnetization by an electric field [2]. The charge and spin of the electron are the physical properties engendered in multiferroic behavior. Experimental and theoretical research has been carried out towards the development of artificial

PROOF OF PRINCIPLE FOR POSITIONING SYSTEM FOR OUTDOOR ROBOTICS APPLICATIONS

Sheila Hanna, Renee Bourgeois, and Dr. Michele McColgan
Siena College

EXAMINING PARITY VIOLATION IN BETA DECAY USING GAMMA RAY POLARIZATION

David Richards and Mark Yuly
Department of Physics, Houghton College

SESSION IIIA. BIOLOGICAL AND MEDICAL PHYSICS

ESTABLISHING INSTITUTION-SPECIFIC ACTION LEVELS FOR EPID-BASED QA FOR IMRT AT THE URMC

A Saldan, D Rosenzweig, A Gray, R Meiler, D Clark, R Abu-Aita, M Schell, and D Cavanaugh
University of Rochester

Portal dosimetry has been used successfully in the clinic for the quality assurance (QA) of intensity-modulated radiation therapy (IMRT) treatment plans, using clinical action levels previously defined by Howell et al. in 2008. At the University of Rochester Medical Center, a review of 3937 fields of 364 patients' treatment plans was undertaken to find institutional action level values unique to this clinic. Data analysis focused on the commonly used gamma parameter. Institutional averages and standard deviations were found for maximum gamma, average gamma, and percentage of a field's fluence area exhibiting a gamma value greater than 1.0. These observations were used to create action levels specific to this clinic, which are expected to reflect institution-specific aspects such

with the structural changes that result, is expected to decrease the activation energy and thus account for the larger hole hopping rate in the deaza-modified DNA.

HOLE TRANSPORT IN DNA: PART II

Alexander J. Breindel, Rachel E. Stuart, William J. Bock, David N. Stelter, Shane M. Kravec, and Esther M. Conwell
University of Rochester

Transport of a hole along the base stack of DNA is relatively facile for a series of adenines(As) paired with thymines (Ts) or for a series of guanines (Gs) paired with cytosines (Cs). However, the speed at which a hole was found to travel was much too small to make useful semiconductor-type devices. Quite recently it was found that replacing one of the electronegative nitrogens (N3 or N7) with a carbon and a hydrogen, thus turning A into deazaadenine, increased the hole speed in what was A/T by a factor 30. To study the effect of the substitution we have carried out simulations for the wavefunction of a hole on an A/T oligomer with As modified by replacing N3 or N7, or both, with C-Hs. The simulations were carried out using QM/MM and the code CP2K. We find, for either N, or both, replaced, the wavefunction of the hole behaves similarly to that of a hole on A/T in being delocalized immediately after hole insertion for up to ~ 20fs, and then becoming localized on one of the modified As. The time for localization could be decreased by placing additional water within ~ 1.88 Å of N3 or N7, encouraging the formation of hydrogen bonds with these nitrogens. Because of their positive charge the hydrogen bonds tend to repel holes. However, these bonds were found to decay on a fs time scale, thus unlikely to affect the hole hopping, which occurs on approximately a ns scale in A/T. Replacement with a C-H of one or both of the electronegative Ns, along with the structural changes that result, is expected to decrease the activation energy and thus account for the larger hole hopping rate in the deaza-modified DNA.

SIMULATING DYNAMICS OF COUPLED JOSEPHSON JUNCTION NEURONS

Siyang Guo
Colgate University

Aiming to understand group behaviors and dynamics of neural networks, we propose an analog circuit model that mimics biological neurons using superconducting Josephson junctions. The Josephson junction neuron has been previously shown to be a fast, accurate circuit model for biological neurons. In this study, we further analyzed the dynamics of the Josephson junction neuron by constructing a coupled system and comparing the results with that of spatially coupled Hodgkin-Huxley neurons. We observed a phase-flip bifurcation in the coupled Josephson junction neurons by numerical

SESSION IIIB. CONDENSED MATTER AND SOLID STATE PHYSICS I

FREQUENCY SYNCHRONIZATION AND NON-LINEAR DYNAMICS IN JOSEPHSON JUNCTION ARRAYS

Matthew Brunetti
Colgate University

We begin with a brief treatment of the concept of frequency synchronization and a description of the locally coupled Kuramoto model (LKM) that we use as the theoretical basis for our experiments. In such a system, the coupling strength determines how quickly and to what degree a system of oscillators will synchronize, if at all. Normally,

interactions and structure. This data will be used to extend a study done previously which compared rate constant data from a continuous wave laser to a pulsed laser.

MAGNETIC SUSCEPTIBILITY MEASUREMENTS

Kyle Conine
SUNY Brockport

In studying the magnetic properties of materials, one measures their susceptibility or response to an applied magnetic field. The applied field is generated by a solenoid

SESSION IVA. ASTROPHYSICS

simulations of the Bremsstrahlung and particle physics processes related to the production of TGFs.

VISUAL ANALYSIS OF MODELS OF THE INFLATION FIELD POTENTIAL
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SESSION IVB. HIGH ENERGY AND PARTICLE ASTROPHYSICS

THE EVOLUTION OF TIME DEPENDENT NON-ASYMPTOTICALLY FLAT BRANES

Taylor Piccarreto
SUNY College at Cortland

In superstring theory, p-branes are solutions whose properties explain facets of physics in dimensions higher than three. The number “p” is the dimensionality of the brane, so a 0-brane is a point, a 1-brane is a string and so on. Some such branes may be thought of as higher dimensional black holes, others may be interpreted as universes parallel to ours, each with their own physical structure. In this work, we study a class of 2-branes in five dimensional (four space + one time) supergravity theory with the strange characteristic of having non-asymptotically flat spacetimes. That is, their gravitational field increases,

EXTRACTING MUON MOMENTUM SCALE CORRECTIONS FOR HADRON COLLIDER EXPERIMENTS

Aaron van Dyne, Arie Bodek, Willis Sakumoto, and Jiyeon Han
Roberts Wesleyan College and the University of Rochester

The full data set from CDF Run II is the best opportunity to make a precise measurement of the electroweak mixing angle using the decay of Z-bosons to dimuon pairs. The proton-antiproton collisions of the Tevatron allow for a more precise measurement than the proton-proton collision of the Large Hadron Collider. The CDF Run II data set has now been corrected, so that an accurate measurement of the electroweak mixing angle can be made in the future. First, a set of cuts were applied to the full CDF Run II data set as well as a Monte Carlo simulation of the signal to maximize the amount of signal while minimizing the amount of background in the data. An additive correction was applied to correct for misalignment and a multiplicative correction was applied to correct for magnetic field strength. These corrections were initially determined based on the mean of the reciprocal of the transverse momentum of muons from Z boson events, and then further corrected based on the Z-mass distribution. Following these corrections, there was good agreement between the forward-backward asymmetry in the data and reconstructed level. In addition, reference plots including phi in the Collins-Soper frame show good agreement between data and simulation. The angular-weighted forward backward asymmetry will allow an accurate measurement of the electroweak mixing angle in the future. The technique was published in A. Bodek, A. van Dyne, J. Y. Han, W. Sakumoto, A. Strelnikov, European Physical Journal C 2012, Volume 72, Number 10, 2194
This project was supported by NSF award PHY-1156339.

SESSION IVC. CONDENSED MATTER AND SOLID STATE PHYSICS II

AN EVAPORATION DEPOSITION SYSTEM FOR THE IN-SITU STUDY OF THIN METAL FILMS

Joshua Mertzlufft and Brandon Hoffman
Department of Physics, Houghton College

With applications of thin films primarily in microelectronics and also emerging applications in the energy industry, it is desirable to have a greater understanding of the underlying characteristics of the films. This project is focused on the design and construction of an ultra-high vacuum physical vapor deposition system that may be used to produce graded thin films on substrates that have been cleaned by an interior ion-mill. The system will also enable researchers to study the effects of annealing in-situ using an associated Michelson-Morley interferometer. The sample heater's heat shield incorporates an infraredylson

diffraction and Hall Effect measurements to determine the crystallite size, film thickness, and mobility.

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