



American Association of Physics Teachers



Central Pennsylvania Section



57<sup>th</sup> Annual Conference  
of the  
**American Association of Physics Teachers**  
**Central Pennsylvania Section**  
AAPT-CPS  
March 27-28, 2009



PENNSTATE



Mont Alto



**57<sup>th</sup> Annual Conference  
of the  
American Association of Physics Teachers  
Central Pennsylvania Section**

Penn State Mont Alto  
Mont Alto, PA

March 27-28, 2009

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**Acknowledgements:**

The AAPT-CPS gratefully acknowledges financial support for the 57<sup>th</sup> Conference provided by the following:

- Eberly College of Science, the Pennsylvania State University (Dr. Norman Freed, Associate Dean)
- University College, the Pennsylvania State University (Dr. John Romano, Dean)
- Penn State - Mont Alto (Dr. David Gnage, Chancellor and Dr. Francis Achampong, Director of Academic Affairs)

**PROGRAM**  
**Friday, March 27<sup>th</sup>, 2009**

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**PTRA WORKSHOP**

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PTRA WORKSHOP - *Physics Laboratory*  
*311 Science & Technology (S&T)*

8:00 - 8:30 PTRA Registration

8:30 - 12:00 Morning Session

12:00 - 1:00 Lunch – *Mill Cafe*

1:00 - 3:30 Afternoon Session

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**AAPT-CPS**

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4:00-6:00 AAPT-CPS Conference Registration – *311 S&T*  
Poster Sessions – *308 S&T*  
Vendors – *308 S&T*

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6:00-6:30 Reception – *Heritage Room, Mill Cafe*

6:30 -7:30 Banquet Dinner – *Heritage Room, Mill Cafe*

*The Heritage Room is in the Mill Café; signs will direct you to the building*

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*Auditorium, General Studies*

7:45-8:00 Welcome address by Dr. David Gnage,  
Chancellor of Penn State Mont Alto

8:00-9:00 Keynote Address – Dr. Francis Halzen  
Ice Fishing for Neutrinos

**Open to the Public**

**PROGRAM**  
**Saturday, March 28<sup>th</sup>, 2009**

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8:00 - 8:30 Continental Breakfast – *304 S&T*

8:00 - 12:00 Registration – *304 S&T*

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**PLENARY SESSIONS**

8:30 - 9:45 Talks – *304 S&T*

9:45 - 10:15 Break – outside *304 S&T*

10:15 - 11:30 Talks – *304 S&T*

11:30 - 12:15 General Business Meeting

12:15 - 2:00 Lunch – *Mill Café*

2:00 - 2:50 Talks – *304 S&T*

2:50 - 3:20 Break – outside *304 S&T*

3:20 - 4:10 Talks – *304 S&T*

4:10 - 4:30 Closing remarks (Mike Doncheski)

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**AAPT-CPS GENERAL BUSINESS MEETING - *304 S&T***

11:30 -11:40 Approval of last business meeting's minutes

11:40 -11:45 President's address (John Reid)

11:45 -11:50 Treasurer's Report (Sardari Khanna)

11:50 -12:05 AAPT-CPS Award Presentations

AAPT-CPS Distinguished Service Award

AAPT-CPS Student Award

12:05 - 12:15 Election of Officers of AAPT-CPS

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112:15 – 2:00 Executive Board Meeting

KEYNOTE SPEAKER  
*Dr. Francis Halzen*

Professor Francis Halzen will be the keynote speaker at the Annual Conference of AAPT-CPS to be held on March 27th and 28th this year. He is the Hilldale Professor and the Gregory Breit Distinguished Professor in the Department of Physics, University of Wisconsin—Madison. He is also the Director of the Institute for Elementary Particle Physics Research at the University.

Prof. Halzen is a theoretician studying problems at the interface of particle physics, astrophysics and cosmology. Since 1987, he has been working on the AMANDA experiment, a first-generation neutrino telescope at the South Pole. AMANDA observations represent a proof of concept for Ice Cube, a kilometer-scale observatory now under construction.

His areas of interest in teaching include:

- Physics in the Arts: a hands-on laboratory course for non-science majors covering acoustics and musical instruments, optics and color.
- Astronomy in the Ice: masters program for high school teachers at University of Wisconsin, River Falls. Course is built upon the science related to the AMANDA project.
- Presented numerous lectures reaching scientists, students and the general public.
- Wrote several articles for popular science magazines in the US and Europe.

Prof. Halzen has been a recipient of the following awards:

- 2007 Helmholtz-Humboldt Research Award (Germany),
- 2005 Doctor of Philosophy Honoris Causa, Uppsala University (Sweden),
- 2000 Best American Science Writing for the essay *Antarctic Dreams*, published in *The Sciences*, New York Academy of Sciences (1999),
- 1999 University of Wisconsin Sesquicentennial Awards: 3 faculty positions given for AMANDA NSF Project,
- 1998 Korean Research Foundation: Collaborative Research with Foreign Distinguished Scholars,
- 1997 The Science Coalition award,
- Great Advances of 1996 for the AMANDA experiment (Washington, DC),
- 1995 Fellow of the American Physical Society.

## LIST OF TALKS

### *304 Science & Technology*

- 8:30 –8:55     **Measuring the Index of Refraction**  
John Reid, Lock Haven University
- 8:55 – 9:20    **Ranking Tasks with the WebWork Quiz System**  
Michael R. Gallis, Penn State Schuylkill
- 9:20-9:45     **SPS Outreach Program at Moravian College**  
Edward A. Roeder, Moravian College
- 9:45-10:15    **Break** – outside *304 S&T*
- 10:15-10:40   **Campus Weather Stations Improve Science and Technology Programs**  
Kip Trout, Penn State York
- 10:40-11:05   **Teaching Module for the German Atomic Bomb Project for High School and College Teachers**  
Nathan C. Hansell, Cedar Crest High School
- 11:05-11:30   **A Modified Rishon Model**  
Patrick Walters, Penn State York
- 11:30-12:15   **General Business Meeting**
- 12:15-2:00    **Lunch**

- 2:00 – 2:25 **Crystallite Size Distribution in 2-D Beds of Randomly Close-Packed, Binary Beads**  
Andrew J. Abraham, Moravian College
- 2:25 – 2:50 **Alternative Approach for Fabrication of Polymer Based Optoelectronic Devices**  
Stephen Swiontek, Lock Haven University
- 2:50– 3:20 **Break** – outside *304 S&T*
- 3:20 – 3:45 **Controlling electron spin transport through Fe-porphyrin**  
J. Baltazar and Laxmidhar Senapati, Lock Haven University
- 3:45 – 4:10 **Structure, Morphology and Formation of the Self Assembled Ag Nanodots on HOPG and Undoped Si(100) under Ambient Conditions**  
Jeff Parks, Anura Goonewardene, Marian Tzolov and Indrajith Senevirathne, Lock Haven University
- 4:10-4:30 Closing Meeting – 304 S&T**

# **ABSTRACTS FOR TALKS**

Saturday, 304 S&T

8:30 –8:55

## **Measuring the Index of Refraction**

John Reid, Lock Haven University

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Using a pen laser and a flat piece of glass or a container of water, one can observe a variety of circles of light. The circles can be understood in terms of the phenomenon of total internal reflection and be used to measure the index of refraction of the medium. Students can be challenged to explain the wide variety of observations in terms on the one underlying phenomenon. This presentation will show several examples of observations and explain the geometry of the circles in terms of total internal reflection as well as other related observations.

8:55-9:20

## **Ranking Tasks with the WebWork Quiz System**

Michael R. Gallis, Penn State Schuylkill

[mrg3@psu.edu](mailto:mrg3@psu.edu)

Ranking Tasks are a type of question which encourages a different mode of thinking than students employ for standard quiz problems. This presentation describes some preliminary efforts on implementing Ranking Tasks on WebWork, a web based quiz system. The questions are used in low stakes quizzes in which the students receive randomized data but identically formatted questions. Ranking Tasks have some unique requirements with regards to the randomization of quiz data. Example Ranking task questions will be discussed, as well as anecdotal assessment of their impact. The computer algorithm for answer assessment will also be presented.

9:20-9:45

**SPS Outreach Program at Moravian College**

Edward A. Roeder, Moravian College

mear01@moravian.edu

Bringing Physics to young people in our community is a priority for the members of the Moravian Chapter of the Society of Physics Students. Our Outreach Program has grown from a very modest start in which we visited one or two elementary school classes each year to its current status in which we annually do numerous science presentations and demonstrations for students in grades one through twelve. In addition, for the past three years, in cooperation with the Bethlehem Area School District, we have organized and supervised a five-week after-school science project for students in grades three through five. This talk will describe the various aspects of our SPS Outreach Program at Moravian College.

**9:45-10:15 Break – outside 304 S&T**

10:15-10:40

**Campus Weather Stations Improve Science and Technology Programs**

Kip Trout, Penn State York

kxt7@psu.edu

Many high schools and colleges can improve their science and technology programs with the addition of an affordable weather station. The addition of a weather station at Penn State York has enhanced our natural science programs, provided opportunities for our computer technology, engineering and science students, assisted faculty in research, improved physical plant decision making, and increased the visibility of the campus in the community. Details of our experiences will be provided to assist those who may be interested in adding an affordable weather station to their campus.

10:40-11:05

**Teaching Module for the German Atomic Bomb Project for High School and College Teachers**

Nathan C. Hansell, Cedar Crest High School

Michael A. Day, Lebanon Valley College

nhansell@clsd.k12.pa.us

The development and use of the atomic bomb during WWII is one of the most significant, and controversial, events of the 20<sup>th</sup> century. Much literature, and hence information, can be found on the Allied program (i.e., the Manhattan project); yet there is little information which is in usable form for teachers in the classroom on the German program. The purpose of the talk is two-fold: (1) to review the literature on the German program, and (2) on the basis of this review to develop a teaching module that should be of use to both high school and college teachers. Sample lesson plans will be made available at the talk.

11:05-11:30

**A Modified Rishon Model**

Patrick Walters, Penn State York

hepresearch@gmail.com

A brief review of Rishon Theory, as developed by Haim Harari, is given, followed by a number of proposed modifications to the theory, hereafter referred to as the Modified Rishon Model. A fairly detailed explanation of the implications of the Modified Rishon Model in cosmology, QCD, and other elements of particle physics is given. Proposed methods for determining the validity of the model, all of which can be pursued with current experimental particle physics data, are presented.

11:30-12:15

**General Business Meeting**

12:15-2:00

**Lunch**

2:00 – 2:25

## **Crystallite Size Distribution in 2-D Beds of Randomly Close-Packed, Binary Beads**

Andrew J. Abraham, Moravian College  
staja02@moravian.edu

Currently, the understanding of the exact structure of a non-crystalline, metallic solid has been less than complete. Traditionally, these solids have been labeled as "amorphous solids" because they do not exhibit any long-range orderliness within their atomic structures. One can make the argument, however, that these non-crystalline, metallic solids are in a state of random close packing, and that they are actually comprised of pockets of highly ordered crystallites which are surrounded by regions of glassy state of irregularly positioned atoms. This physical characteristic of a solid can be quantified by the degree of crystallinity, which we define as the fraction of crystalline atoms in a solid specimen. The primary goal of this research project is to determine the first quantitative estimate of the degree of crystallinity for a randomly close-packed two-dimensional assembly of monodisperse macroscopic spheres as a model system. In addition, we are interested in constructing a histogram of the population of crystallites as a function of their size. It is important to study the atomic structuring of solids because the exact atomic configuration of a solid dictates the transport of atoms by thermal fluctuation, leading to determination of important thermophysical properties of material specimens. Examples are: heat conductivity, thermal diffusivity, spectral emissivity, heat capacity, the thermal expansion coefficient, and so on. It is, however, difficult to accurately determine the exact locations of a large number of atoms within a solid, due to the microscopic scales involved. As a close analog, a macroscopic arrangement of high-precision steel bearing balls should be able to provide a good approximation of the exact mechanisms found in the microscopic world. The apparatus used consists of a 2-D cell, in which some 600 steel bearing balls (either 2.51mm or 3.23mm in diameter) can be assembled into a random close-packed state. An image is captured each time the beads are reassembled into a new randomly close-packed state. It takes roughly 10<sup>15</sup> atoms to cover an area the size of 1 cm<sup>2</sup>. Repetitive assembly and imaging can provide the data approximating the randomly close-packed state of non-crystalline alloy specimen. It is also, in principle, possible to infer three-dimensional information from two-dimensional results. Due to the volume of data expected for this work, computer processing is deemed necessary. The programming was partitioned into algorithms for image recognition, followed by crystallite identification. The image recognition entails determination of the coordinates of the centers of individual beads. The digital image file is scanned horizontally, line by line, to draw a vertical line close to the center of each bead, followed by a vertical scan to obtain a horizontal line through the center of each bead. The intersection of the two lines provides the approximate

center of each bead. A circle of bead radius is moved about the center to find the exact center of each bead by minimizing the error signal from the miss match of the circle and the image of each bead. Crystallites are then searched using an algorithm which assembles a crystallite when every bead within the crystallite forms an equilateral triangle with at least two of its nearest touching neighbors.

Individual crystallites are counted and classified by the amount of area each crystallite occupies in order to construct the histogram of the number of crystallites of a given size (by area). The resulting crystallite size distribution shows a functional form that increases steeply to the maximum value followed by a slower decrease with increasing crystallite size. Very large occurrences of crystallites are seen at small crystallite sizes (crystallites of size 3, 4, or 5 beads) and the decrease in frequency of occurrence as the crystallites become larger (crystallites of size 10, 20, or 30 beads). Interestingly enough, the histogram may exhibit a bimodal distribution of crystallite sizes, depending on the ratio of large to small beads. A 50%-50% ratio of large to small beads will not show this bimodal distribution, however it is evident when considering the two extremes (ratios of either mostly large or mostly small beads).

2:25 – 2:50

### **Alternative Approach for Fabrication of Polymer Based Optoelectronic Devices**

Stephen Swiontek, Lock Haven University  
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Light emitting diodes (LED's) are commonly used in commercial products as indicator lights in computers and appliances, warning and indicator lights on automobiles, and light sources in traffic lights and flashlights. Their high efficiency and long life makes them preferred replacement for the traditional incandescent light bulbs. The high efficiency and long life will be explained by a parallel between the principles of operation of the three main sources of light: incandescent bulb, fluorescent bulb, and LED. Historically, the LEDs are manufactured on crystalline materials. This works quite well for discrete elements, but meets many challenges for large area applications. Alternative solution is offered by the polymer LEDs, which utilize an organic polymer film as the light emitter.

A polymer LED is a device structure that uses materials deposited on top of each other as thin films allowing efficient charge injection. The bottom layer of indium tin oxide is predeposited on glass slides and it serves as the positive electrode. A conducting polymer (Plexcore#61650;) is deposited on top of it and it facilitates the injection of charges in the polymer film on top of it. Poly-phenylene vinylene (PPV) film is the actual light emitter. The device structure is finalized by a metal electrode deposited directly on the PPV film. There are consistent efforts in our laboratory to replace the

vacuum deposition of the metal electrode by less equipment demanding techniques. Electroless deposition of silver was mainly investigated. My contribution is in exploring a method preventing the unwanted chemical interactions on the PPV surface during the electroless deposition. Complete devices were tested electrically and their current-voltage characteristics will be presented. The microstructure of the metal electrodes was studied by Scanning Electron Microscopy. The optical spectra of the polymer will be also presented.

## **2:50-3:20      Break – outside 304 S&T**

3:30 – 3:45

### **Controlling electron spin transport through Fe-porphyrin**

J. Baltazar and Laxmidhar Senapati, Lock Haven University  
lisenapat@lhup.edu

The field of molecular electronics offers one possible solution to the problem faced by silicon technology as device miniaturization continues into the nanoscale regime. Though limited to laboratory experiments, recent years have seen a lot of progress towards an another emerging chapter in molecular electronics with the observation of spin dependent electron transport in single wall and multiwalled carbon nanotubes, semiconductor quantum dots connected by a molecular linkers, organic thin films, and self-assembled organic monolayers. Specifically, the use of organic molecules and monolayers as viable medium for spin transport is more promising due to larger spin coherence length in molecular systems over metals and semiconductors. Weak spin-orbit interaction and spin-flip scattering in organic molecules makes it more promising as building blocks for the future generation spintronics and quantum computing devices. We will present our theoretical study of electron spin transport through a porphyrin molecular. A first-principles gradient corrected density functional theory and Landauer-Buttiker multi-channel formalism is used to study the spin-polarized transport properties of the molecular wire. The transport is calculated through magnetic contacts as well as by bringing a magnetic nano-island on top of the Fe-porphyrin molecule. We found in both cases the transport is sensitive to spin polarization.

3:45 – 4:10

### **Structure, Morphology and Formation of the Self Assembled Ag Nanodots on HOPG and Undoped Si(100) under Ambient Conditions**

Jeff Parks, Anura Goonewardene, Marian Tzolov and Indrajith

Senevirathne, Lock Haven University

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Current technological applications require nanostructures as the efficiency, power and versatility improves with shrinking size of these devices. Self assembly of epitaxial nanodots is a bottom-up approach in forming nanostructures. Formation of sputter deposited Ag nanodots on cleaned undoped ambient Si(100) substrate at RT (~295K) is investigated in terms of kinetics and the energy minimization of the substrate (HOPG and Si(100)) and (Ag) Silver system via contact mode Atomic Force Microscopy (AFM). At a Ag coverage of 60ML nucleation of the nanodots were seen, implying Stranski Krastanov growth mode. At a coverage of 120ML the self assembled nanodots are clearly seen. These nanodots are observed to have 40nm in width and 10nm in height. At an increase Ag coverage (120ML and 180ML) it is observed the number density of Ag nanodots increase in lock step. Higher the coverage size characteristics observed to show a higher variance. When annealed at successively higher temperatures (373K, 473K, 573K) for an interval of 5min the structures seem to dissolve, implying kinetically limited growth. Conductivity and optical reflectivity measurements on these nanostructures will also be discussed.

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### **4:10-4:30 Closing Meeting – 304 S&T**

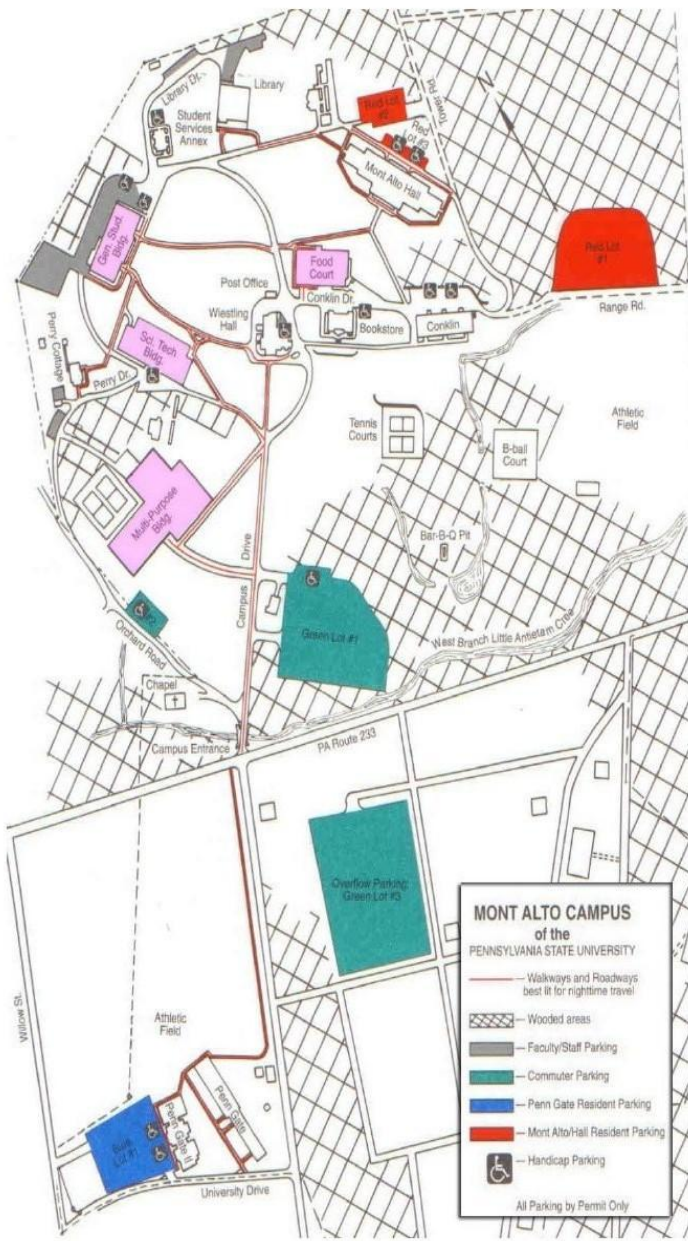
Raffle

Closing Remarks

## NOTES

## NOTES

## NOTES



**MONT ALTO CAMPUS**  
of the  
PENNSYLVANIA STATE UNIVERSITY

-  Walkways and Roadways best fit for nighttime travel
-  Wooded areas
-  Faculty/Staff Parking
-  Commuter Parking
-  Penn Gate Resident Parking
-  Mont Alto/Hall Resident Parking
-  Handicap Parking

All Parking by Permit Only

## **Keynote Address**

Friday March 27<sup>th</sup>, 2009, 8:00PM Auditorium  
Open to the Public

### **Ice Fishing for Neutrinos**

Scientists are melting holes in the bottom of the world!

We have melted half of the eighty holes over two km deep in the Antarctic icecap to be used as astronomical observatories. Into each hole is lowered a string knotted with basketball-sized light detectors which are sensitive to the shimmering blue light emitted in the surrounding clear ice when ghostly particles called neutrinos pass through the Earth. These neutrinos are cosmic messengers from the most violent processes in the universe, for example giant black holes gobbling up stars in the heart of quasars, and gamma-ray bursts which are the biggest explosions since the Big Bang. Neutrinos will tell us if there are dark matter particles trapped in the heart of the Sun, and perhaps even reveal if there are additional dimensions in space.



***Dr. Francis Halzen***

***Hilldale Professor and Gregory Breit Distinguished Professor  
Director of the Institute for Elementary Particle Physics Research  
Department of Physics  
University of Wisconsin - Madison***