TAAPT Annual Meeting

March 26-27, 2010, University Center, University of Tennessee at Martin

PROGRAM

FRIDAY, MARCH 26

5:00 PM Registration and Social Hour (Room 206, University Center (UC))

6:00 PM Banquet (Room 206, UC)

7:30 PM After-dinner Presentation (Watkins Auditorium, Room 100 UC)
Self-Organization -Nature's Intelligent Design
Clint Sprott, The University of Wisconsin-Madison

SATURDAY, MARCH 27

7:00 AM Registration and Breakfast (Room 229)

8:00 AM Opening Remarks (Room 230, UC)

8:15 AM Plenary Talk
Non-Newtonian Dynamics,
Clint Sprott, The University of Wisconsin-Madison

9:00 AM **Physics First in TN**
Sheila Pirkle
Austin Peay State University

9:15 AM **Computational Physics for High School Students**
Jaime R. Taylor
Austin Peay State University

9:30 AM **Using Diagnostic Testing to Inform Instruction in Physics and Astronomy Courses at TTU**
Stephen Robinson
Tennessee Tech University

9:45 AM **Efforts to Enhance Physics Teacher Production**
Ron Henderson
Middle Tennessee State University

10: 00 AM **Torque, Rotational Motion, and the DYNAFLEX PRO® Sports Gyro Exerciser**
Terry King
Ravenwood High School / APSU

10: 15 AM Break and Poster Session

10: 45 AM Business Meeting

11: 15 PM **Invited talk**
(Over)Dose in Imaging: What's Going On?
Vic Montemayor
Middle Tennessee State University

11:45 AM **First/Last day of class**
Arthur Carpenter
Austin Peay State University Ft. Campbell

12:00 PM **Characterization of Polylactic Glycolic Acid and Self Assembled Monolayers**
Kimberly Eakins
Tennessee State University

12:15 PM Lunch Break (Room 229)

1:15 PM **TAAPT-Through the Years…**
Kathy Daniel
Oakland High School

1: 30 PM Awards Presentations

Visit to the Department of Chemistry & Physics, demonstrations
Johnson Engineering & Natural Sciences Building

ORAL ABSTRACT

Physics First in Tennessee: 2009 Program Results

Sheila F. Pirkle
Austin Peay State University

Many high school physics courses are taught by science teachers not certified to teach physics; there are few opportunities for these teachers to continue their studies. With a grant from the Tennessee Higher Education Commission, during the summer of 2009 Austin Peay State University provided a review course for secondary science or mathematics teachers. The course was designed to prepare the teachers to solve algebra-based physics problems and practice laboratory activities. Eighteen teachers participated in this conceptually-oriented physics course. The results of the program will be presented.

Computational Physics for High School Students

Jaime R. Taylor
Austin Peay State University

In the Fall of 2007 the Austin Peay State University (APSU) physics department was encouraged to submit a proposal for a Governor's School. A computational physics Governor's School was proposed. The challenges of teaching computational physics, which requires differential equations and programming skills, to high school students will be described along with how some of the challenges have been addressed.

Efforts to Enhance Physics Teacher Production

Ron Henderson
Middle Tennessee State University

There is a great shortage of high school teachers in this country. Among the science, technology, engineering, and mathematics (STEM) disciplines, the greatest need is in physics. At the same time, there are very few physics graduates being produced at the bachelor's level. According to the economics of Supply and Demand, physics departments are not doing very well. There is a great demand for a product that physics departments have the ability to supply. The AAPT has taken a leadership role to address the shortage of high school physics teachers by forming the Physics Teacher Education Coalition to provide resources to universities that educate physics teachers. Other national organizations have also become involved in response to the multitude of reports from the US government including "A Nation at Risk," "Rising Above the Gathering Storm," and "Before It's Too Late." In particular, the University of Texas at Austin has developed a comprehensive program to increase the number of STEM high school teachers in a manner that is being duplicated at universities across the nation, including Middle Tennessee State University.

Using Diagnostic Testing to Inform Instruction in Physics and Astronomy Courses at TTU

Steven Robinson
Tennessee Tech University

I will discuss how we have used the Force Concept Inventory (FCI) on a long-term basis to diagnose student difficulties in conceptual understanding in the first semester of introductory physics (both algebra-based and calculus-based). Analysis of the results has allowed us to focus changes in instruction, resulting in significant improvement in student conceptual understanding. On a shorter-term basis the Astronomy Diagnostic Test (ADT) has been used to the same effect in our introductory astronomy course sequence. I will also discuss the different pedagogical approaches that have been used to address these conceptual difficulties.

(Over)Dose in Imaging: What's Going On?

Vic Montemayor
Dept. of Physics & Astronomy, Middle Tennessee State University

The past six months have witnessed much concern and activity about the dose delivered to patients by a certain type of CT scan. In particular, the FDA has issued a warning associated with unnecessary doses delivered to patients by CT scans in general. In this talk I will overview the reason for this warning and what has been done as a result of the warning. In the process, I will also describe the fundamentals of a CT scan along with the physics of dose delivery.

Torque, Rotational Motion, and the DYNAFLEX PRO® Sports Gyro Exerciser

Terry King
Ravenwood High School / APSU

A discussion of how the sports gyro exerciser works and is used to improve grip and arm strength. The physics of rotational motion and the physiology of sports training are combined in this device. The gyro is available at Academy Sports & Outdoors and Dick’s Sporting Goods for under $20.

Good ideas for the First and Last day of Class

Arthur Carpenter
APSU Ft. Campbell

On the first day of class physics students can be introduced to their place in the universe with simple hands on demonstrations. There is something to be learned here by students at all levels. The last day of class can be a learning experience. Have you ever had a "conference" with students as presenters?

Characterization of Polylactic Glycolic Acid and Self Assembled Monolayers

Kimberly Eakins
Tennessee State University

(A) It has become a recent phenomenon to verify the efficiency of nanoparticles potential to be effective drug carriers. Submicron liposome and polymers such as Poly (lactic- co- glycolic acid) are being evaluated for their potential role in stealth or long circulating drug delivery systems. Nanoparticle carriers have the advantage of cross cellular membrane with ease; modularized design that provides a generic approach for delivery a class of drugs to the target area. Imaging of PLGA (poly (lactic glycolic acid)) nanoparticles at nanometer resolution enable us to study its surface structure, size distribution, and morphology. In this project, we use the atomic force microscope (AFM) and the electron microscope (EM) to determine the size and structure of PLGA.

(B) A new method of particle lithography that has the ability to generate organosilane nanostructures is nowadays an essential component in many areas of modern science. Nanolithography is used to make patterns using latex mesospheres, thiols and/ or silanes on various surfaces. Bottoms up approaches used to create nanopatterns are impressively being studied because of its potential in the development of electronics, optoelectronics, and crystallization, biological and chemical sensors. We expect to develop Self Assembled Monolayers (SAMs) using various techniques of nanolithography to grow patterns on surfaces. Using latex spheres we plan to create close packed hexagonal patterns and analyze them using the Atomic Force Microscope (AFM) looking at particularly the periodicity, how well defined the shapes are, and the structures z- height. Comparison of the two imaging methods and their implications will be discussed in the presentation.

POSTER ABSTRACTS

Effects of Refrigeration on Elasticity of Human Erythrocytes Under Shear Stress in Human Blood Serum

Keaten Holley, Casey Carter,
MTSU

Elasticity of human red blood cells (RBCs) is studied by means of laser tweezers exerting forces to cause mechanical deformations to the cells in a particular environment. In this case we have studied elasticity of fresh RBCs as compared to refrigerated RBCs in their own human blood serum. The deformations we have observed have been the result of dragging an RBC through a viscous fluid. We found some interesting, non-linear behavior between the net force on the red blood cell and its longitudinal displacement, contrasting that of typical stretching measurements with force probes. Our current focus is to investigate the elasticity of blood cells infected with sickle cell anemia. The elasticity of sickle RBCs in different physiological environments is an interesting topic of study as they tend to be stiffer, as well as more brittle than normal RBCs, and can block capillaries in a patient, causing stroke. As only refrigerated blood is available for these types of measurements, refrigeration effects can be valuable as to validate our current measurements observing deformation of sickle RBCs as we continue to research this area of study.

A study of Photonic Band Gaps in Synthetic Opals

Brandon Slayton
Middle Tennessee State University

Photonic crystals were first proposed by Yablonovich in the early ninties, and since have been growing as an area of study for science and technology. These crystals prevent certain wavelengths of light from propagating through the material due to the pattern and refraction indices of the crystal. To demonstrate this property, I have successfully formed synthetic opals on glass microscope slides and tested them with a spectrometer to show the location of these bandgaps. The bandgaps produced are not as deep as possible, but the process, which takes about three weeks, can be easily modified to produce better crystals.

A simple evaporative method for varying the thickness of CdSe nanocrystal films for applications in photovoltaics

Hung Le
Middle Tennessee State University

The CdSe nanocrystals were synthesis in oleic acid and are in use for the photovoltaic systems showed promising results due to the method of how they were deposited on the substrate plates. The nanocrystals are suspended in solvents; hexanes, toluene, or chloroform. They are then allow to evaporate in a fume hood with plates of indium tin oxide substrates. Through preliminary results the layers of nanocrystals have a high resistance where they did not short circuit the system. The tests were conducted in a simple solar simulator, constructed here at MTSU. More work are being conducted to ensure that they can be apply to the application of the photovoltaic systems.

Luke Reves
Middle Tennessee State University

Radio Jove: A presentation of the aspects of radio astronomy.
This presentation will concentrate on the Radio Jove project and what research has been done previously by the presenter. This presentation will cover some fundamentals on radio astronomy and its applications. Some topics that will be discussed will be related to radio astronomy such as solar bursts, Jupiter's magnetosphere and could also touch on some deep space subjects such as radio galaxies, pulsars and other deep space objects. An important purpose of this project is to increase public awareness of the program Radio Jove and its accessibility. Because the nature of the project is simple and fundamental, this is an excellent way to introduce students from high school to undergraduates on how a science project is professionally carried out. Other topics may include personal research such as the calibration and conversion of Skypipe units to Kelvin, possible Radio Jove 2 receiver info, setting up an antenna site and discuss on recent events and updates with the Radio Jove program.

Quantum Teleportation of Information via Two Pairs of Entangled Photons

Hannah Norris
Middle Tennessee State University

The realization of faithful transmission of information in quantum communication, completely secure information exchange in quantum cryptography, and exponentially faster speeds in quantum computing fundamentally require a Bell-type entangled state. In our study, we focus on a single β-barium borate, BaB_2O_4 (BBO) crystal that generates polarization-entangled photons under type-II spontaneous parametric down conversion, in which the down converted photons are emitted into two cones: one horizontally polarized (h), the other vertically (v). In the region where the cones overlap, the two spectrally multimode photons exist in a polarization entangled state. Thus, the correlated photons are produced in an entangled state of the form $|h,v>+|v,h>$. We analyze the degree of entanglement of

the twine photons and then measure the teleportation fidelity. Using the relationship we discover between the two entangled photons, we then use two pairs of entangled photons which have been interacted with each other to measure the degree of entanglement through entanglement swapping, and compare this result with the result for the initial pair of photons. We then use these results to further learn of the teleportation fidelity for two pairs of entangled photons, and compare our findings with those for the teleportation fidelity of a single pair.

Preparation of Prussian blue coated gold electrodes for use in a gaseous hydrogen peroxide sensor
Joshua Parker
Middle Tennessee State University
A deposition technique was developed for depositing Prussian blue onto a gold macro and a gold micro electrode. The stability characteristics were observed in different buffers and at different pH values. The stability was found to be consistent with currently published materials, with the Prussian blue films surviving several hours of scanning. The hydrogen peroxide detection deposition limits were tested and compared to the pre-deposition performance. Both electrodes showed an order of magnitude decrease in their hydrogen peroxide detection limits, with confident detection of Hydrogen peroxide for the gold macro and gold microelectrodes placed at 5.4×10^{-7} M and 1.6×10^{-7} M, respectively.

Measurement of Faraday Effect in Flint Glass - SF-59
Luis Herrera, Misganaw Getaneh
University of Tennessee at Martin
The effect of magnetic field in the propagation of red laser beam in flint glass is investigated. A plane polarized laser beam with wavelength of 650 nm is propagated along a 10 cm long flint glass (SF-59) rod which is placed along the axis of a solenoid. The beam is subjected to increasing axial magnetic field produced by externally controlled current in the solenoid. An analyzer and a detector system placed at the exit of the beam at the other end of the glass rod shows that the plane of polarization of the beam is rotated, confirming the well known Faraday Effect. The amount of rotation is directly proportional to the magnitude of the magnetic field. The Verdet constant for flint glass (SF-59) is determined from the measurements and it is in very good agreement with other reported values.

Application of a linear multistep method to atomic kinetics
John Salter, Samuel N. Jator, & Justin Oelgoetz
APSU
Transient phenomena are important to modeling emission spectra arising from many time-dependent sources such as solar flares, flares accretion disks, and other X-ray flares that have been observed in active galactic nuclei (AGN). These phenomena are modeled by the same set of coupled collisional-radiative atomic

kinetics equations that are used model steady state plasmas. The phenomena differ from the steady state case in that they are solved by integrating the collisional-radiative kinetics equations forward in time from a set of initial conditions using a numerical method, often 4^{th} or 5^{th} order Runge-Kutta methods. This poster presents results from an ongoing effort which aims to investigate the appropriateness of a comparable hybrid method, which is a combination of a Runge-Kutta and a linear-multistep method, to solve the coupled collisional-radiative atomic kinetics equations, and to determine if any resulting "speed up" would allow for a more complete physical model to be used.

Teaching Exoplanets

Hilary Ball
MTSU Physics and Astronomy Department

Why should middle and high school students learn about exoplanets, and how could this material be taught while keeping the students' interest?

Curiosity is a key component in teaching and taking part in the sciences – 'why does this act the way it does?' and 'what happens when we do this?' are questions that frequently lead to further study, a goal teachers strive toward bringing out in their students. It is for this reason that the study of exoplanets should be embraced by middle and high school teachers – there are so many questions that could be asked about the subject, such as "Are we alone in the universe?" and "Is our planet, our situation, unique?" that simply cannot be answered with the current information. Such open ended questions could lead to creative projects and open discussion in the classroom about the many possibilities that are out there.

Two main methods to keep in mind when teaching about exoplanets, how we find them, and what constitutes and 'Earth-like planet,' are using hands-on activities to engage students' minds and embracing their creativity so that they connect personally with the material and take more of the information with them.