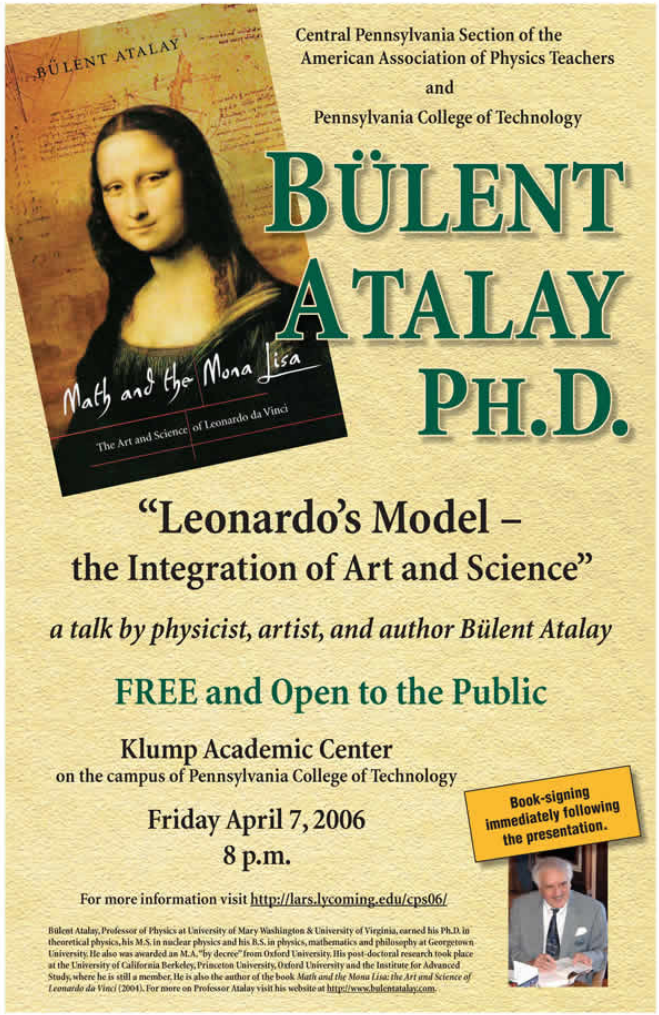

CPS-AAPT Annual Meeting
Pennsylvania College of Technology

54th Meeting

of the

Central Pennsylvania Section

of

The American Association of Physics Teachers

Pennsylvania College of Technology

Williamsport, PA

April 7-8, 2006

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Program of Events

Friday April 7th, 2006

Registration: 12:00 – 5:00 **Applied Technology and Health Services Building (ATHS) First Floor Atrium**

Campus Tour: A Penn College student ambassador will be giving a tour of the campus starting at 1:00 PM. This walking tour will last about 45 minutes and will start in the ATHS lobby, next to the registration table.

Session A, Room E203 (ATHS)

2:00 Welcome by Dr. Jeff Vetock, Assistant Dean of Integrated Studies

2:10 – 2:30
A-1
Energy First in the Physics Curriculum
Joseph E. LeBlanc
Pennsylvania College of Technology
(jleblanc@pct.edu)

The topic of Energy is left to the later chapters in most physics textbooks, and in many real time classroom experiences this results in a coverage which is secondary, partial, or superficial. The Principle of Conservation of Energy is more fundamental than Newton's Laws of Dynamics, and can be presented earlier in the semester, and then used to explain phenomena both in a scalar nature, with energies, and in a vector nature, with forces. A new order of topics will be presented, with a logical progression on how to introduce Forces from the concept of Work, and dynamics from the concept of Conservation of Energy.

2:30 – 2:50
A-2
Cosmic Ray Detector
Kevin Mann & Tom Walker
Lock Haven University
(kmann@lhup.edu)

We will present a discussion of our work done in the building of a cosmic ray detector. The detector is made of two scintillator paddles that we obtained from the Fermi National Accelerator Laboratory. The work which we performed on it was to repair broken components as well as creating a light proof box in which the detector is then placed for experiments. We will discuss; briefly the historical significance, and finally the results obtained from experiments conducted.

2:50 – 3:10
A-3
Magnet Magic! Powerful Magnets for Amazing Physics
Krishna Chowdary
Bucknell University Department of Physics
kchowdar@bucknell.edu

Improvements in rare-earth magnet processing have made powerful permanent magnets cheap to purchase. These are not your parents' (refrigerator) magnets! Using these magnets, it is possible for students to perform simple desktop experiments involving motors and generators. We have incorporated these magnets into the lecture and laboratory for the introductory calculus based physics sequence as well as the general education sequence at Bucknell University. We have also modified these demonstration experiments as part of a new outreach effort that our physics majors do with local high school classes. In this talk, we will show an amazingly simple motor as well as a simple generator that allow for demonstrations and explanations of the Right Hand Rule for magnetic forces, and Faraday's Law for changing flux. We will present the exercises we have written for students, and participants will be able to construct both the simple motor and the simple generator.

3:10 – 3:30
A-4
Learning Projectile Motion with the Computer Game Scorched 3D
John Jurcevic
Susquehanna University
(jurcevic@susqu.edu)

For most of our students, video games have always existed during their lives. Video games are a natural part of their lives and we should take advantage of this medium to teach physics in a manner that is engrossing for our students. I recently found the open-source game Scorched 3D and I think it can help students understand projectile motion by allowing them to visualize the motion through beautifully rendered 3-dimensional graphics. It also provides students with an interface through which they can take data (initial speed, angle, and range) and then model the motion.

Break (3:30 – 3:40)

3:40 – 4:00
A-5
A New Look at a Classic Demonstration: The Sunset Experiment - Rayleigh Scattering, or Not?
Kelly Krieble
Moravian College
(krieblek@moravian.edu)

The "sunset demonstration" is a classic demo which is used to illustrate why the sky is blue and why sunsets are red. We will show data from a time-resolved quantitative measurement of the spectrum of light from this demo arrangement via the use of a computer interfaced Ocean Optics spectrometer. The results will be compared to the Rayleigh scattering formula. The spectrometers used in this demonstration were purchased as part of a grant from Research Corporation for outreach and the use of modern scientific equipment in secondary schools. A brief overview of the outreach and equipment loan program will also be given.

4:00 – 4:20
A-6
Generalizations of the Brachistochrone Problem
John Gemmer
Millersville University
(jagemmer@marauder.millersville.edu)

Consider a frictionless surface in a gravitational field that need not be uniform. Given two points A and B on the surface, what curve is traced out by a particle that starts at A and reaches B in the shortest time? This is a generalization of the traditional brachistochrone problem first solved by Newton and Bernoulli. This project studies this problem for simple surfaces such as surfaces of revolution and central force potentials. We solve this more general problem using the Euler-Lagrange equation and conservation of mechanical energy.

4:20 – 4:40
A-7
Astronomy full of Wonder
Bob Barrett
Messiah College
(barrett@messiah.edu)

This talk examines how one might gauge creativity and apply this measure to the cosmos. The talk will explore the variety of stellar objects, the beauty of celestial objects, and the mystery that seem to multiply when we consider the heavens.

4:40 – 5:00
A-8
Combating Nuclear Terrorism: Challenges in the Ongoing Deployment of Radiation Portal Monitors
Jim Borgardt
Juniata College
(BORGARDT@Juniata.Edu)

Radiation portal monitors (RPM) have been deployed at border crossings, sea ports, airport hubs, and storage facilities to detect illicit radioactive materials which could be used for nuclear terrorism. This talk will focus on an overview of the many challenges that have manifested themselves in this ongoing effort –environmental, fiscal, political and physical. These devices have been both touted in the press as a method by which borders might be hermitically sealed against radioactive materials, and as an abject failure in the effort to do so. This will be shown to be an instance where the reality lies in the gray area between these two extremes.

Session B, ATHS First Floor Atrium Lobby - Poster Session
5:00 – 6:00

B-1
The Effects of Physical Parameters on the Circular Hydraulic Jump
Casey Hoffman
Moravian College

More colloquially known as the “kitchen sink” experiment, a hydraulic jump occurs when the fluid flow speed equals the speed of surface waves, and is analogous to a shock front. Previous researchers have noticed complex patterns forming within the region inside the hydraulic jump radius. We present results of an experimental study to examine the spatial patterns formed by a circular hydraulic jump and the relation of these patterns to the controllable parameters of our experimental system.

B-2
Microcontrollers and Robots
Carl Gravely & Scott Seroskie
Pennsylvania College of Technology
(gracar22@email.pct.edu)

LEGS or “Linear Electronic Group Spider” was part of a required project for the ELT 235 class for the electrical majors. L.E.G.S. was created by a group and by obtaining the parts via donation or buying. The project is focused around the use of microcontrollers and using the programming to control them. LEGS is a robotic spider that has several programs including movements, music and songs, lights, and a motion detection system built by electronics to “search, find, and attack” its prey, so to say. L.E.G.S. is no more than a half a cubic foot, and runs off of 9 volt batteries, or a power supply. The program used in the microcontroller is programmed using company software in a windows

environment, and transferred via a serial cable to the robot. Several programs can be uploaded; one at a time by simple clicks of a mouse, so changing programs of a microcontroller is easily accomplished.

B-3
HST Photometry of Red Supergiant Variables in Spiral Galaxy M101
Robert Nowicki
Susquehanna University
(nowicki@susqu.edu)

Using Hubble Space Telescope images taken with the Advanced Camera for Surveys, we obtained photometry of 33 red supergiant variables (RSVs) in the spiral galaxy M101 in the F555W and F814W broadband filters. By combining our photometry with previously measured period for the variables, we derived a period-luminosity relationship for the apparent magnitude in the F814W band of $I(F814W) = (27.7 \pm 0.2) - (2.2 \pm 0.5) \log(P)$. We also plotted the RSVs in a color-magnitude diagram to show that they are red supergiants.

B-4
Light Pressure on a Diaphragm
Tanya Benway and J.W. Dooley
Millersville University
(trbenway@marauder.millersville.edu)

An aluminum foil diaphragm, stretched over a small embroidery hoop is deflected when light from a camera flash lamp strikes it. We have observed the deflection at atmospheric pressure and in a vacuum, finding evidence for both impulsive and thermal components to the deflection. The impulsive response has a rise time less than 50 microseconds, and a time duration of about 5 milliseconds, on the order of the duration of the flash. In vacuum, this is followed by ringing at the natural “drumhead” frequency of the diaphragm for several hundred milliseconds. The presumed thermal response is a relaxation to the original state which takes times on the order of 10 seconds.

B-5
Quantum Dynamics of a Kicked Harmonic Oscillator
Laura Ingalls Huntley
Franklin and Marshall College
(lhuntley@fandm.edu)

A classical system of two masses connected by a spring and subjected to a time-dependent pulse is used to model a kicked quantum harmonic oscillator in free one-dimensional space. This model is of interest because it is related to the Mössbauer effect where the kick is due to the emission of a gamma ray. Furthermore, the model results in coherent states and can be solved analytically. The Schrödinger equation is written using center of mass coordinates, and the wave function of the two-particle system is found after performing two extended Galilean transformations and using separation of

variables. The average energy of the system and the probability that the system is in the unperturbed harmonic oscillator state are calculated.

B-6

Developing experimental skills from a simple study to measure the acoustic length of open-open pipes

N. Daddario, J. White, M.J.Pearson
Juniata College
(pearson@juniata.edu)

The acoustic theory of a pipe shows a mathematical relationship between the resonant frequency and acoustic length inherent in the pipe. It is found that the physical length of a pipe needs a correction factor because the acoustic wave reflects past the physical boundaries. Previous studies have shown that the correction factor is 0.61r, where r is the radius of the pipe. Using PVC piping it is possible to calculate the value of the proportionality constant by measuring the room temperature and the radius, length, and resonant frequency of a pipe. By drilling holes of various sizes into the pipe cavity it is possible to change the acoustic length without changing the physical dimensions of the pipe. With a 2.7mm hole drilled three quarters of the way from the end of a pipe, the acoustic length was found to change from 0.617 ± 0.016m to 0.610 ± 0.016m. More data is currently being taken to see whether this change is significant. Also, further work is being done to improve the accuracy of this study. By modifying a simple acoustical experiment a number of useful skills can be developed, such as good experimental technique, error analysis, reproducing theory and explaining findings that are not available in text books.

B-7

Inspirational Physics: A Non-Invasive Imaging System for Blood Flow

Dan Sidor
Juniata College
(pearson@juniata.edu)

Non-invasive imaging of blood flow is an exciting way to gain experience in many areas of physics and in linking physics to biology and medicine. In this initial study an optical system capable of visualizing the flow of blood through the small vessels of the nailfold was constructed. This involved making low-cost modifications to a microscope and identifying and testing light sources and filters to enhance images of blood flow. Videos were captured directly onto a computer and processed using a combination of in-house and freely available software. Currently the system is able to visualize vessel morphology, blood flow, and even single white cells rolling along vessel walls. Future work is necessary to increase optical magnification and to apply digital image processing to further enhance resolution. This system also has clinical applications to investigate and diagnose disorders affecting the circulation, such as diabetes and hypertension.

B-8

Role of Multiple External Representations in Teaching and Learning

Khusro Kidwai
Penn State University
(khk122@psu.edu)

We routinely use text, diagrams, pictures, tables, equations, graphs, knowledge maps etc. in our instruction. Increasing we find ourselves teaching in computer based environments where we use animations, interactive exercises, virtual worlds, walk-throughs (and the list goes on). Researchers call these external (in contrast to internal – "what is inside the head") forms of knowledge representation,
Multiple External Representations (MERs). MERs can aid the teaching and learning process in many ways, for example MERs: "support cognitive processes in learning and problem solving" (Ainsworth, 1999); "support communication, thinking, and learning" (Schnotz, 2002); "computer environment permits tremendous opportunities for presenting content, such as animation, sound, and interactive exercises in addition to displaying printed words"(Robinson, 2002). In this virtual "poster" presentation we will look at a typology for MERs that is based on the functions that MERs serve. We will also look at examples of MERs and how technology enhanced MERs are playing an ever increasing role in the teaching and learning process.

Banquet 6:00 – 8:00 PM at LeJeune Chef Restaurant

Keynote talk

"Leonardo's Model – The Integration of Art and Science"
by
Dr. Bulent Atalay

will start at 8 PM in the Klump Academic Center Auditorium

Saturday April 8th, 2006

8:00 – 8:20 **Continental Breakfast and Registration**
(Registration will be from 8:00 – 9:30 Saturday morning)

8:20 – 9:00 **General Business Meeting**
(Open to all members – please plan on attending this meeting)

9:00 – 9:20
C-1
Making the Most of Metals in Your Microwave: Studies of the Heating and Sintering of Powdered Metals in Separate Electric and Magnetic Fields Using a Single Mode Microwave Cavity
Darin T. Zimmerman
Penn State Altoona
(dtz1@psu.edu)

Unlike bulk metals, we observe metal-powder compacts to be strongly absorbing in microwave fields. The details of the underlying heating mechanisms are neither well documented nor well understood. We consider two questions: "How are powder-metal compacts heated so efficiently by microwave radiation?" and "Does the initial stage of sintering fit conventional models or does the explanation require a microwave-specific model?" These two questions are addressed on four fronts: (a) identification of the separate contributions of the electric and magnetic fields, particle size, and packing density to the heating and sintering using a single-mode microwave system; (b) an empirical study of the complex permittivity and permeability of powder metal compacts as a function of the same parameters; (c) computer simulations of the absorption and heating; and (d) evaluation of the first stage of sintering by direct examination of heated (sintered) samples with scanning electron microscopy (SEM).

9:20 – 9:40
C-2
Is There Physics in Vacuum?
Shahin Shabanian
Pennsylvania College of Technology
(sshabani@pct.edu)

A brief history of classical vacuum is discussed. Quantum interpretation of vacuum is described leading to and in light of the Casimir Effect. The concept of Zero-Point Field (ZPF), or synonymously, Zero-Point Energy (ZPE) is discussed as an attempt to describe the "structural incompleteness" of the quantum mechanics. ZPF approach reveals a possibility to prove that the classical physics encompasses the quantum mechanics; that is, the quantum mechanics is a subset of the classical physics if the fluctuation of vacuum of space is included (as a force or energy) in the classical physics structure.

9:40 – 10:00
C-3
Fun with a Square Well
M. A. Doncheski *and R. W. Robinett, Penn State; L. Gilbert and M. Belloni, Davidson*
Penn State University
(doctord@psu.edu)

The characteristics that we associate with Quantum Mechanics (QM) – namely, quantization, waves (and consequently, superposition), and probability – are separately familiar concepts, either in physics or mathematics, though combined in a unique manner in QM. In the teaching and learning of QM, we often rely upon simple models rather than more complicated real world models. Probably the simplest model that exhibits all of the characteristics of QM is the Infinite Square Well (ISW). This model is simple both conceptually and mathematically, and can be compared with such real world situations as a billiard ball bouncing back and forth, and a vibrating guitar string. Recently, in a series of papers with various collaborators, I have explored the ISW and minimal extensions (asymmetric ISW and one or more delta function potentials inside an ISW); from those studies came a variety of visualization techniques involving wave packets which can serve as a bridge between classical and quantum mechanics. Some mathematical and physical surprises will be discussed.

10:00 – 10:20
C-4
Characterization of Thin-films by Surface Plasmon Technique
Leah Gallek
Millersville University
(leahgalemore@hotmail.com)

A table-top apparatus was constructed using the Kretchmann configuration to create and observe the presence of surface plasmon resonance, using 60-nm thick Ag films. Surface plasmons (SP) are excited when perpendicularly polarized light from a He-Ne laser is incident on the interface at the critical angle of total internal reflection, and are observed by a characteristic dip in the intensity of the light reflected off the interface. The optical parameters of the thin film, such as refractive and absorption indices, and thickness, can be determined from the theoretical fit of the reflection minimum. The paper presents results for thin silver films, as well as thin polypyrrole films, deposited on glass plates. These experiments aim the preliminary description of the thin silver films, which we will use later as intermediate films for investigating SiO2 nano-structured thin films. In addition, the paper discusses the learning goals that will be persuade by including this experiment in the lab portion of the new course in Optics that will be offered in our department within the next two years.

10:20 – 10:40 Break

10:40 – 11:00
C-5
Evaluating Integrals without Calculus in Introductory Physics
Donald E. Fahnline
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Many introductory physics textbooks relate integrals to the area under a graph and then use students' knowledge of the formulae for the areas of simple geometric shapes to effectively evaluate a few integrals without using calculus. Within this context, this article presents a general geometric-algebraic method for evaluating additional integrals important for introductory physics. Examples include the work done by an elastic force, the work done by an inverse square force, and the moment of inertia of a thin uniform rod.

11:00 – 11:20
C-6
Isaac Newton and Intelligent Design
David A. Larrabee
East Stroudsburg University
(dlarrabee@po-box.esu.edu)

Behind today's debate of evolution and Intelligent Design (ID) is a view of Science and Religion in conflict. This view of the relationship between science and religion dates to John William Draper (ca 1874) and Andrew Dickenson White (ca 1869). Today this position is recognized as poor scholarship in the History of Science. The idea ID goes back to at least Plato, long before the "principle of falsification". ID has played an important role in the development of the physical sciences (including Newton's Principia). We will review how one such argument was handled in the past, long before the "Principle of Falsification" was regarded as a fundamental principle in the philosophy of modern science. In fact, this process is at work today within the biological community. Newton saw his theory as requiring that God must have intervened in the creation of the solar system. This was countered by Kant (ca 1765) and Laplace (1796) by the creation of the Nebular hypothesis. Today this hypothesis has proved increasingly useful and is generally accepted (although modified). Consequently, Newton's original argument is no longer considered a legitimate ID argument

11:20 – 11:40
C-7
Lies Creationists Tell
Donald Simanek
Lock Haven University
(dsimanek@lhup.edu)

Creationists frequently bend the truth and misrepresent science, appealing to "common sense" notions appealing to nonscientists. These include "order does not arise from disorder", "every effect has a cause", and "something cannot arise from nothing". These will be shown to be wrong or misleading, and in any case, insufficient to support the hypothesis of an "intelligent designer".

11:40 – 12:00
C-8
Intelligent Design, Fraudulent Pseudoscience
Donald Simanek
Lock Haven University
(dsimanek@lhup.edu)

Creationism has evolved into "intelligent design", presenting a political challenge to science in the school curriculum. Not just biological evolution is denied by ID, for it also attacks the very definition of science and its methodology, compromising physics as well. Yet, I will show, ID is still nothing more than an emotionally appealing hidden assumption leading to an untestable conclusion by way of an irreducible logical gap.

12:00– Closing Remarks