NORTH CAROLINA SECTION OF THE AMERICAN ASSOCIATION OF PHYSICS TEACHERS

SACS-AAPT

Society of Physics Students
A Universe of Wonder

# The Fall Joint Meeting of the NCS-AAPT, SACS-AAPT, and the SPS

### UNC Asheville

### Nov 18-19, 2011

Directions to the UNC Asheville campus and a campus map are available on the conference web site http://physics.unca.edu/fall-2011-ncs-aapt-meeting. Park in Lots 7a or 7b across from Zeis Hall (Building 24 on the campus map).

## Schedule

# Friday Nov 18, 2011

**5:00-6:00p Registration**

On-site registration will occur in the first floor lobby of Rhoads/Robinson Hall (Building 17 on the campus map).

**6:00-7:45 Banquet**

The Friday night banquet and Saturday lunch will both occur in the Private Dining Room of the University Dining Hall (Building 20 on the campus map). Show your badge and give your banquet ticket to the cashier, then visit the cafeteria line where you will find a variety of dining options.

**8:00 Friday Evening Keynote Room 125 Rhoades/Robinson Hall (Large Lecture Hall)**

Our featured speaker will be David Cassidy who will present "A Short History of Physics in the American Century" which is also the title of his recently published book.

David Cassidy has been Professor of Natural Science at Hofstra University, Hempstead, NY, since 1990. He has a Ph.D. from Purdue and a BA and MS from Rutgers. He has also been Assistant Professor at the University of Regensburg in Germany and Associate Editor of the first two of the enormous Collected Papers of Albert Einstein, published by the Princeton University Press.

Specialties: History of physical science, esp. in U.S. and Germany, History of Meteorology, Science and culture in the United States, German studies, Computer history, and Science education for non-scientists.

Awards: Pfizer Award of the History of Science Society, Science Writing Award of the American Institute of Physics for ***Uncertainty: The Life and Science of Werner Heisenberg***.

# Saturday, November 19, 2011

**Moderator: Dr. James Perkins**

**Robinson Hall Room 125 (Large Lecture Hall)**

**8:00 AM**: **Leveraging Technology to help students learn outside and inside the classroom**

Taha Mzoughi , MAT Physics Coordinator/Advisor, Noyce I Project Director, Dept. of Biology and Physics, Kennesaw State University, 1000 Chastain Rd., #1202, Kennesaw, GA 30144-5591, Office Phone: 678 797 2152 - FAX: 770 302 4202, tmzoughi@kennesaw.edu
http://physci.kennesaw.edu/mzoughi/

For non-majors, introductory physics courses are often touted as the hardest college courses. The difficulty is partly due to the complexity of some of the abstract concepts covered in these courses and to the total number of concepts that are often crammed into the curriculum. This presentation focuses on an active learning method focusing on an extensive use of technology that we have adopted in teaching introductory courses. In this case, teaching follows a hybrid format where most of the learning occurs outside of class. Lecture time is used to answer and discuss questions and to explore the topics students find interesting.

The technologies used include computer mediated and hands-on activities. Instead of lectures students complete online multimedia quizzes, embedding both lecture type recording segments and simulations. The quiz format helps students focus on the intricacies of the topic covered. Homework is also completed online. It includes both traditional end of the chapter questions and simulation mediated questions. Hands-on laboratory activities are preceded by pre-laboratory

simulation mediated activities. The method had been used to teach trigonometry-based physics and conceptual physics.

**Robinson Hall Room 125 (Large Lecture Hall)**

**8:15 AM: Math Bench**

Don Franklin, Adjunct Professor, Mercer University, dgfrank1@aol.com

The University of Maryland has developed a software program to help Biology majors prepare for the rigorous math skills needed to be successful in higher level courses.
The basic skills are taught in our First Semester Physics classes. This gives Physics Professors and Teachers a chance to dialog with the Biology staff and help them by preparing their students. A demonstration of the site will be included in the presentation.

This is an NSF and HHMI funded project.

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**Robinson Hall Room 239**

**8:15 AM – 9:45 AM Workshop #1:** Martin Kamela, Physics Department, Elon University http://www.elon.edu/mkamela

SPS/Physics Club Leadership Development Workshop. At the National SPS meeting this September the suggestion was to invite both Physics Club advisers and student leaders to attend such a workshop. This workshop is aimed at both SPS/Physics Club advisers and student leaders, and is based on the premise that supporting a community for physics students is a valuable contribution to their educational experience. As part of the workshop participants will explore programmatic ideas for their clubs, discuss best practices for communication within the club, explore avenues for support for club activities, and discuss the missions of SPS chapters within their institutions.

Randy Booker, Gordon Shepherd, Mike Larsen (+2 students)

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**Robinson Hall Room 125 (Large Lecture Hall)**

**8:30 AM: Vortex explosion transition in a type II superconductor**

Milind Kunchur, University of South Carolina, USC Dept. of Physics and Astronomy, 712 Main St., PSC room 404, Columbia, SC 29208, kunchur@sc.edu, (803)777-1907, Manlai Liang, University of South Carolina, Alexander Gurevich, Old Dominion University

A magnetic field produces quantized flux vortices in a type II superconductor. A transport current through the superconductor produces a Lorentz force on the vortex causing it to move. This in turn leads to an electric field and resistance. In this work we study this resistive state and

find evidence for a transition to a state where the vortex explodes and abruptly fills the width of the sample.

**Robinson Hall Room 125 (Large Lecture Hall)**

**8:45 AM: Gelin' in the Physics Lab**

Aaron Titus, High Point University, 833 Montlieu Ave, High Point, NC 27262, <atitus@highpoint.edu>

Gel electrophoresis is a separation technique used to identify DNA. Yet, it is also an excellent application of introductory physics principles. A uniform electric field is set up across a gel. Negatively charged DNA molecules migrate toward higher electric potential. Due to drag, the DNA molecules travel at a terminal speed and students can apply Newton's second law to investigate the drag on the DNA. In this experiment, groups of introductory physics students applied different voltages to the gel. They took initial and final pictures of the DNA and used Tracker's line profile to measure the distance traveled by the DNA bands in the gel. Their data was aggregated to see if the terminal speed was proportional to the applied voltage. The results indicated that the DNA moving through the gel cannot be understood by a simple model. The experiment has tremendous value for an introductory physics laboratory. The experiment, its results, and its usefulness in teaching physics will be presented.

**Robinson Hall Room 125 (Large Lecture Hall)**

**9:00 AM: GPS Physics - Case Studies for Exploring Real World Motion**

J.B. Sharma, Gainesville State College, Gainesville, GA 30503, jsharma@gsc.edu, 678 717 3812

The ubiquity of the Global Positioning System (GPS) technology allows for modeling and analysis of real world motion incurred by students. The GPS unit captures the 3D real time position vector that contains the kinematics of motion. If the mass of the moving object is known, the energy and power transactions can be explored. Case studies of student projects involving both human and machine propelled motion will be presented and discussed. The examination of the phase plots reveal many facets of the motion and are very useful as interpretive exercises. The pedagogic utility of this approach and tips for integration into introductory mechanics courses will also be discussed.

**Robinson Hall Room 125 (Large Lecture Hall)**

**9:15 AM: Asperger’s Syndrome in the physics classroom**

Elena Mendez, Converse College, Spartanburg, S.C. 29302, (864) 596-9127, elena.mendez@converse.edu ; John Riley, University of South Carolina at Upstate, Spartanburg, S.C., (863) 503-5775, jriley@uscupstate.edu; Brittani Williams, Converse College, Spartanburg, S.C. 29302

Asperger's Syndrome and its traits are more prevalent among mathematics and science students than among those studying an area in the humanities. With the recent increase in the diagnosis of students with Asperger's syndrome, there is a significant likelihood of encountering a student with Asperger type traits or an actual diagnosis of Asperger's Syndrome in the high school or college physics classroom. We will summarize recent literature describing relevant characteristics associated with Asperger's syndrome including strengths, challenges and factors related to student success.

**Robinson Hall Room 125 (Large Lecture Hall)**

**9:30 AM: Differences and Similarities:** (Teaching Introductory Physics)

Mikhail M. Agrest, College of Charleston, 66 George Street, Charleston, SC, 29424, (843) 953-1359; FAX: (843) 953-4824, AgrestM@cofc.edu http://agrestm.people.cofc.edu/

The ability to create concepts is the unique gift of the intellect. That is the capability of recognizing similarities in events that look different and distinguishing differences in those looking similar.

Scientists study nature, collect data, describe what they observe and eventually build the basis for summarizing this information and create the concepts for further establishing models – the tools for practical use and further investigation of the universe.
It is essential not only to empower students with the ability for using the concepts, but it is also important to teach them to search and to see the similarities and differences.
The above concept will be illustrated by numerous examples borrowed from a variety of fields of study sometimes not even related to Physics, nor science at all. Employing this experience would help teachers to develop students' habit to analyze i.e. to search for differences and similarities and therefore to avoid misconceptions.

**Robinson Hall Room 125 (Large Lecture Hall)**

**9:45 AM: Meaning of Science and the Social Context: The Case of Nineteenth-Century India**

Rajive Tiwari, Physics Department, Belmont Abbey College, Belmont, NC 28012, 704-461-6756 (W), 704-807-0799 (M), 704-461-6239 (F), rajivetiwari@bac.edu

Western Science arrived in India in early nineteenth century via the British colonial education system. In order to assess the native response to this new knowledge, several science-related articles in popular Hindi-language magazines and newspapers were analyzed. It was found that what the new knowledge meant to the authors was determined in part by social factors such as their national aspirations in opposition to the colonial rule, the concurrent spread of Christianity and the rise of Hindu reform movements.

**Robinson Hall Room 125 (Large Lecture Hall)**

**10:00 AM: The Discovery of Black Holes: A Historical Approach.**

**GUEST SPEAKER**

David Cassidy, Professor of Natural Science at Hofstra University, Hempstead, NY
http://www.dcassidybooks.com/

**10:45 AM Break**

**Robinson Hall Room 125 (Large Lecture Hall)**

**11:00 AM: Exploring the Integration of Computational Modeling in the ASU Modeling Curriculum**

John M. Aiken[1] (presenter, graduate student, jaiken1@student.gsu.edu),

**Graduate Student** (SEE POSTER associated with this paper)

John B. Burk[2], Marcos D. Caballero[3], Michael F. Schatz[4],
Brian D. Thoms[1] (corresponding author, bthoms@gsu.edu, 404-413-6045)

We describe the implementation of computational modeling in a ninth grade classroom in the context of the Arizona Modeling Instruction physics curriculum. Using a high-level programming environment (VPython), students develop computational models to predict the motion of objects under a variety of physical situations (e.g., constant net force), to simulate real world phenomenon (e.g., car crash), and to visualize abstract quantities (e.g., acceleration). We discuss how VPython allows students to utilize all four structures that describe a model as given by the ASU Modeling Instruction curriculum. Implications for future work will also be discussed.

[1]Department of Physics, Georgia State University, Atlanta, GA
[2]The Westminster Schools, Atlanta, GA
[3]Department of Physics, University of Colorado at Boulder, Boulder, CO
[4]School of Physics, Georgia Institute of Technology, Atlanta, GA

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**Robinson Hall Room 217**

**11:00 AM – 12:30 PM Workshop #3:** William Junkin, Professor of Physics and Director of Instructional Technology, Eckerd College, (727) 864-8239, junkinwf@eckerd.edu, Physics

Professor Anne Cox.

In-class Polling for All Learners (iPAL), our workshop will show how we can allow students to use a mixture of clickers and web-enabled devices to respond to in-class polling through a Moodle module.
Greg Wilson, Gordon Shepherd, Ellen Adams, Amira Price, J.B. Sharma, William Brandon

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**Robinson Hall Room 125 (Large Lecture Hall)**

**11:15 AM: Non-Science Majors Academic Motivations in Science Courses**

Delena Bell Gatch, Georgia Southern University, P.O. Box 8031, Statesboro, GA 30460, (912) 478-7354, dbgatch@georgiasouthern.edu

For non-science majors, science courses are often perceived as difficult. However, these students are required to successfully complete science courses. This provides an excellent opportunity to study student motivation and the impact of motivation on academic behaviors and performance. In an attempt to understand academic motivations, students' responses on the Academic Motivation Scale were analyzed in a preliminary study. It was determined that students' levels of Intrinsic Motivation and Amotivation, but not Extrinsic Motivation, were significantly related to their academic behaviors. Currently, a study is being undertaken to survey students' academic motivations in introductory trigonometry-based physics courses. These responses will be correlated with time on task while completing assignments, and gains on either the Force Concepts Inventory or the Conceptual Survey of Electricity and Magnetism. A full explanation of Student Learning Theory of Motivation and preliminary results will be presented in an effort to identify individuals interested in becoming involved in phase II of the project.

**Robinson Hall Room 125 (Large Lecture Hall)**

**11:30 AM: Weaving Undergraduate Research into the Laboratory Curriculum**

William Brandon, Department of Chemistry and Physics, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, Fax: 910.521.6638, md0017@bravemail.uncp.edu

Low-to-intermediate undergraduate research projects are modified and woven into UNCP standard laboratory curriculum. The lab activities described involve straightforward commercial hardware and software integration. In particular, the Science Workshop (SW) interface/software coupled with a soundcard/freeware or a regulated power supply in addition to other simple components lead to interesting variations in standard laboratory activities. One approach integrates the standard PC soundcard/freeware with the SW interface/software in constructing a variety of automated low frequency spectrum analyzers to investigate transient effects on

resonances associated with driven oscillators, both mechanical and electrical, in addition to vibrating strings and cantilevers. The other approach combines a regulated power supply with the (SW) interface/software in an automated LED optimization apparatus providing an accurate method of extracting Planck's constant from most light emitting diodes in undergraduate lab activities— providing a more consistent methodology, to our knowledge, than any previous method described in the literature.

**Robinson Hall Room 125 (Large Lecture Hall)**

**11:45 AM: Monte-Carlo Simulation to Optimize Scintillator Systems**

Rob Argue (Elon University),

**Undergraduate Student**

Each Global Nuclear Defense Network (GND Net) sensor detects gamma radiation with a low power avalanche photodiode (APD) coupled to a scintillator. For the required sensitivity, the scintillator must be much larger than the APD. To optimize the signal strength of the APD either the position of the APD on the scintillator's surface must be optimized, or light must be directed onto the APD using a light guide with optimized geometry and optical properties. A special-purpose Monte-Carlo code simulates how light behaves inside of a scintillator/detector or scintillator/light guide/detector system. Experiments agree with simulations. The code can handle a variety of configurations contemplated for future scintillator systems.

**Robinson Hall Room 125 (Large Lecture Hall)**

**Noon: Poetry Writing in a General Physics Class**

Bill Schmidt, Department of Chemistry, Physics and Geoscience, Meredith College, 3800 Hillsborough St. Raleigh, NC 27607, (919)760-8616 (O), (919)760-2844 (F), schmidtw@meredith.edu

Student engagement techniques during class time have been shown to improve conceptual understanding in introductory courses, if done effectively. These techniques often include answering conceptual questions and working problems during class in a group setting. Smaller class sizes provide the opportunity for direct feedback and discussion of student work during class time. One engagement technique that provides a creative and non-typical challenge to students is to require a few poetry assignments reflective of a specific context of physics. This provides a more student-centered discussion and a fun, light-hearted approach to learning what is often perceived as a purely logical subject. The assignments, the structure of the class, and the merits of poetry will be discussed.

**Robinson Hall Room 125 (Large Lecture Hall)**

**12:15 PM: What can PIRA do for you?**

Keith Warren, NC State University, Campus Box 8202, Raleigh, NC 27695-8202, (919) 513-2708 (office), (919) 515-6538 (fax), keith.warren@ncsu.edu

The Physics Instructional Resource Association (PIRA) is a group of professionals dedicated to the support and advancement of physics education. PIRA, with sponsorship of the Apparatus Committee, is an affiliate of the AAPT. PIRA members include teachers, professors, laboratory and demonstration specialists, community outreach coordinators and others. We work to develop and share effective teaching tools and techniques for physics teachers everywhere. The free exchange of knowledge and the willingness to support colleagues anywhere are hallmarks of the organization. This talk will encourage local participation in PIRA as well as discuss the many resources provided for free to physics teachers everywhere. These will include the Demonstration Classification Scheme (DCS), the Demonstrations Bibliography, TAP-L and more.

**Dining Hall: Private Dining Room**

**12:30 PM: Lunch and Business Meeting**

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## End of Business Meeting Discussion: Cracker Barrel on the Demise of Physics Departments

**Budget Cuts Threaten Physics Departments – Is Your Department Next?**

Moderator: Russ Herman, Department of Physics and Physical Oceanography, UNC Wilmington, Wilmington, NC, 28403-5606, herman@uncw.edu

This is not merely an academic concern at UNC Wilmington. After facing 15.8% budget cuts, the department was told in July that it will be merged with the Department of Geography and Geology as of January 1, 2012. We will discuss what happened and what our future looks like.

If this could happen at UNCW, then what about the other 500+ bachelor's-only physics departments across the country. How does cutting or trimming physics from state universities impact other programs, the region, and the nation? We may know the answers to this, but can we relay these answers to the non-physicists? What national support is there when state budgets target low enrollments programs? What support should there be as more and more low enrollment physics programs are targeted?

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**Afternoon Session**
**Moderator: Dr. Randy Booker**

**Robinson Hall Room 125 (Large Lecture Hall)**

**2:00 PM: Using YouTube in Introductory Modern Physics Course**

Tatiana A. Krivosheev, Clayton State University, 2000 Clayton State Blvd, Morrow, GA 30240, 678-466-4783, Fax: 678-466-4797, TatianaKrivosheev@mail.clayton.edu

We present our experience of using YouTube videos in the Introductory Modern Physics class. In particular, we focus on an amazing popular science video on the foundations of the Einstein's special relativity produced in 1964 in the former Soviet Union.
Equipment needed: computer, projector

**Robinson Hall Room 125 (Large Lecture Hall)**

**2:15 PM: Making YouTube Physics Videos Without a Camera**

Michael Ruiz, Department of Physics, University of North Carolina Asheville, Asheville, NC 28804, Office Phone: 828-232-2281, FAX: 828-251-6397, ruiz@unca.edu

YouTube is now very pervasive among students and you can quickly make short YouTube videos for your students without using a camera. All you need is a $20 headset. The software is free. Making such YouTube videos with a PC and CamStudio will be discussed, as well as setting up your YouTube Channel and Playlists for your courses. You can make a 5-minute video, upload it to YouTube, and add it to your Playlist from home. Students watch YouTube videos so naturally and you can take requests from students on topics that need more explanation. Examples will be shown from introductory liberal-arts courses and a course for majors called "Theoretical Physics." See http://www.youtube.com/user/doctorphys and instructions for making such videos at http://ctl.unca.edu/variete

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**Robinson Hall Room 217**

**2:30 PM – 4:00 PM - Workshop #2:** Aaron Titus, High Point University

**Video Analysis with Tracker.** Tracker is free, open-source video analysis software that is well-suited for both introductory and advanced physics. Participants will be given a step-by-step, introductory physics experiment that can be adapted to a college or high school physics class. Participants will analyze a video with Tracker and will perform the same measurements and calculations expected of students. Additional complete experiments for topics ranging from mechanics to E&M to optics will be provided.

Teresa Page, Ron Curtin, Don Olive, Eric Chapman, William Brandon (+ 3 students), Nikki Malatin, Mike Larsen (+2 students), Taha Mzoughi, Jon McDuffie, Zachary Luna, Kendall Taylor, Nick Russo, Judy Beck

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**Robinson Hall Room 125 (Large Lecture Hall)**

### 2:30 PM: Optimization of a Magnetic Nanoparticle-Polymer Composite Material for Microactuation Applications

Willem Prins, Elon University, 8001 CB, Elon University, Elon, NC 27244, (919) 360-0620, Fax: (336) 278-6258

**Undergraduate Student**

Micro-scale magnetic actuators could be used in a wide variety of applications, from replicating the function of biological cilia to mixing and pumping fluids in microfluidic channels. We have developed a novel material which is a composite of magnetic nanoparticles suspended in a silicone polymer matrix. The iron content allows magnetic control while the polymer lends flexibility, making the material ideally suited for magnetic micro-actuators. However, the very iron which makes the material magnetically controllable also makes it less flexible, and so careful design of the material is critical.

I varied the magnetic content of this material and measured the magnetic permeability and elastic modulus of each sample. The degree of bending under magnetic actuation was predicted with a theoretical model and measured experimentally. I show that both experimental and theoretical results indicate that material properties are optimized for actuation applications at a magnetic concentration of 37% wt.

*Sponsored by Dr. Tony Crider and Dr. Ben Evans

**Robinson Hall Room 125 (Large Lecture Hall)**

### 2:45 PM: The Ubiquitous Computer Power Supply as a Multipurpose Laboratory Instrument

Mac Davis* Department of Chemistry and Physics, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, Fax: 910.521.6638, md0017@bravemail.uncp.edu

**Undergraduate Student**

Discarded personal computer power supplies (PC-PS) usually find their way into landfills. However, they are quite easily transformed into several useful benchtop instruments. As an incremental power supply the voltage rails provide twenty different voltage combinations ranging from -24V to +24V for studying DC circuits. For labs at the intermediate and advanced levels, PC-PS architecture lends itself quite naturally to power a variety of transistors, op amps, integrated circuit components, motors and diodes. For modest high power applications the PC-PS can provide the direct current necessary to produce reasonably intense magnetic flux densities in a variety of coils and for powering audio amplifiers in alternating current applications. Finally, a fool-proofed modular device allowing a user controlled voltage and current to components such as signal diodes, light emitting diodes and class IIIa laser diodes for subsequent characterization, costing less than ten dollars, is described.

* Sponsored by W.D. Brandon, Department of Chemistry and Physics, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, Fax: 910.521.6638 william.brandon@uncp.edu

**Robinson Hall Room 125 (Large Lecture Hall)**

**3:00 PM: Gas-rich Interstellar Clouds Near and Far**

Varsha Kulkarni, University of South Carolina, Department of Physics and Astronomy, 712 Main Street, Columbia, SC 29208, kulkarni@sc.edu, (803)-777-6293

Evolution of interstellar matter in galaxies is closely linked to that of stars and heavy elements. Absorption lines produced by galaxies in the light from bright background sources such as quasars or gamma-ray bursts offer a powerful tool to study evolution of interstellar gas in galaxies over billions of years. The strongest of these absorption systems are especially interesting because they contain most of the cold, neutral gas reservoir needed for star formation. We will describe results of our studies of atomic and molecular gas in the most gas-rich distant galaxies and compare them with the interstellar gas in the Milky Way and nearby galaxies. Finally, we will discuss a few examples of how astronomy can be used in undergraduate teaching to bring together ideas in many different aspects of introductory physics.

**Robinson Hall Room 125 (Large Lecture Hall)**

**3:15 PM: Using Tracker to Measure the Length of the Sidereal Day**

Mario Belloni, Physics Department, Davidson College, PO Box 6910, Davidson, NC 28035-6910. (704) 894-2320, mabelloni@davidson.edu

At Davidson College we are currently re-vamping our introductory astronomy course to include a laboratory for the fall of 2012. As part of this endeavor, we are upgrading our observing and astrophotography equipment and techniques. One laboratory in the “naked-eye astronomy”

portion of the course is focused on measuring the sidereal day. Instead of measuring the angular displacement of stars from canned star trail images, we propose to use a group of still 30-second images taken 9 ½ minutes apart. To analyze these images we use the free and open-source Tracker video analysis program to measure the sidereal day. We use the feature in Tracker which automatically creates a "movie" of still images and then allows the user to define the time interval between images. In this talk we show our preliminary results and propose possible future improvements.

The Open Source Physics Project is supported by the National Science Foundation (DUE-0442581).

**Robinson Hall Room 125 (Large Lecture Hall)**

**3:30 PM: The 2012 Transit of Venus - a "physics for the public" opportunity**

Frank Lock, retired high school physics teacher, 4424 Sardis Rd. Gainesville, GA 30506, fasterlock@att.net, 941-475-1578

The 2012 transit of Venus on June 5, 2012 is an excellent opportunity for physics teachers to present physics and astronomy concepts to the public. On the east cost of the United States the transit will be visible beginning at about 6 p.m., depending on your location, and will continue through sunset. Many physics teachers and professors have access to telescopes. This provides them with the opportunity to make presentations to the public about an event that will not be visible on earth again until 2117.

The presenter will describe his experience in making such presentations in the past, as well as his experience involving the transit of Venus in 2004.

**Robinson Hall Room 125 (Large Lecture Hall)**

**3:45 PM: Vacuum Ping Pong Cannon**

Donald F. Collins, Warren Wilson College, PO Box 9000, Asheville, NC 28815, (828) 298-4131, dcollins@warren-wilson.edu

A vacuum cannon built from transparent PVC pipe was built that shoots ping-pong balls at a tremendous velocity. A low-cost high speed video camera (Casio EX-FH25) has proven capable of photographing the ping pong ball along the 3-meter muzzle of the cannon in a low-resolution video using 1000 frames/sec. The exit velocity of the ball was found to be about 350 m/sec. The initial acceleration peaks at about 50,000 m/sec$^2$ and quickly levels off to about 20,000 m/sec$^2$. Simple Newtonian physics coupled with kinetic theory for ideal gas predicts comparable results. The simple ping pong cannon provides exceptionally rich applications of physics, thermodynamics, and aerodynamics.

**Robinson Hall Room 125 (Large Lecture Hall)**

**4:00 PM: High-Speed Video Analysis of the Ballistic Motion of a Skateboard**

James Perkins, University of North Carolina at Asheville, CPO 2430, One University Heights, Asheville, NC 28804, (828) 232-5133, Fax: (828) 251-6397, jperkins@unca.edu

Professionally produced and publically available high-speed footage of complex motion or motion too fast for the unaided eye is widely available on the internet. Combining this already captured data with commercially available and/or free video analysis software provides for an abundance of opportunities for computer based laboratory exercises with essentially no cost, setup, or safety risk. Analysis of one such piece of high speed footage is made into an exercise for a calculus-based, introductory mechanics course. 1000 frame per second video of a skateboarding maneuver called a "360 kickflip" is analyzed by students to extract physical parameters of the trick. Students were able to observe the parabolic motion of the center of mass of the skateboard and the conservation of its angular momentum during the approximately three tenths of a second during which the skateboard was under only the influence of gravity.

**Robinson Hall Room 125 (Large Lecture Hall)**

**4:15 PM: A Group Project in Introductory Physics: Working with Physics Simulations**

Judy Beck, UNC Asheville, Department of Physics, CPO #2430, One University Heights, Asheville, NC 28804. (828) 251-6049, (828) 251-6397 (fax), jbeck@unca.edu

Physics simulations can provide excellent experiences to support student learning in physics. In this project, introductory physics students have the opportunity to create as well as participate in these learning experiences. Each week during the lab session, a different small group of students is responsible for designing and presenting to the class an exercise or activity that involves the use of a web-based physics simulation. The same small group follows up by assessing their classmates' work and summarizing the experience. The most commonly used simulations are those from the University of Colorado at Boulder's PhET (Physics Educational Technology) website (http://phet.colorado.edu/ ). The project assignment details, discussion of results, and student feedback will be presented.

## POSTERS

**Robinson Hall Lobby**

**Posters should be displayed throughout the meeting at least until 2:30 PM so that there will be ample time for attendees to decide on which to vote for.**

## Some Design Considerations for Amplitude Modulated Laser Systems

Austin Griffin* Department of Chemistry and Physics, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, **Fax:** 910.521.6638, md0017@bravemail.uncp.edu

**Undergraduate Student Poster**

Recent investigations into the operating characteristics of light emitting diodes [1,2] along with laboratory based electro-optical projects involving laser diodes and photodiodes has generated interest in using the latter components to build an amplitude modulated (AM) laser transmitter and receiver. In applying some fundamental principles gained from that earlier work a simple, yet *high fidelity*, modular AM laser transmitter and receiver was designed, prototyped and built. All phases of the design, construction and testing process are described and a working version is exhibited.

* Sponsored by W.D. Brandon, Department of Chemistry and Physics, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, Fax: 910.521.6638 william.brandon@uncp.edu

**Robinson Hall Lobby**

## Inexpensive Custom Light Detector with Commercial Grade Specifications

Andrew Neal* and Fredrick Shirmer* **Department of Chemistry and Physics,** University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, **Fax:** 910.521.6638, md0017@bravemail.uncp.edu

**Undergraduate Student Poster**

Several metrics should be met when designing, building, and implementing quality components for intermediate level physics teaching labs and research. Some of these metrics include performance, cost, simplicity, robustness, versatility and compatibility with standard and/or pre-existing equipment. This approach is utilized in the design and construction of a light detector which satisfies all of the aforementioned criteria. The photodetector described is based on a surplused Estonian FDK-155 photodiode. This mounted version rivals the performance of a similarly mounted commercial photodiode (*Thorlabs* SM05 PD with SMR05 mount), in electro-optical behavior while providing equal versatility and footprint in electrical and opto-mechanical connectivity. However, one major difference is the cost; the total cost of custom-built detector is less than ten percent than that of the commercial version.

* Sponsored by W.D. Brandon, Department of Chemistry and Physics, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, 910.521.6247, Fax: 910.521.6638 william.brandon@uncp.edu

**Robinson Hall Lobby**

## Improving Future High School Physics Teachers' Preparedness

Brian D. Thoms[1] (presenter, corresponding author, bthoms@gsu.edu, 404-413-6045)
Sumith Doluweera[1], and Brett Criswell[2]

## Poster

A new 7-week summer course has been developed to improve the physics pedagogical content knowledge and the confidence of future physics teachers. Master of Arts in Teaching students at Georgia State University have an option to pursue broad-field certification (physics, chemistry, biology, and earth science). The students who take this option have a variety of backgrounds in physics, ranging from one year of algebra-based physics to full physics or engineering degrees and have a commensurate range in physics conceptual understanding. Since student teaching occurs in the fall and spring terms, the short summer semester is the primary opportunity for content coursework. We have developed the new course to simultaneously address the physics misconceptions of the future teachers while teaching physics pedagogical content knowledge and expose them to research-proven teaching methods in a SCALE-UP classroom. The conceptual physics knowledge and attitudes of these students have been investigated during pilot semesters. In a single 7-week summer term, normalized gains in Force Concept Inventory scores averaged 0.43 (half of students showed gains above 0.50) and students also show large increases in their self-evaluations of their comfort and preparedness in teaching physics.

[1]Department of Physics and Astronomy, Georgia State University, Atlanta, GA
[2]Middle-Secondary Education and Instructional Technology, Georgia State University, Atlanta, GA

**Robinson Hall Lobby**

## Self-efficacy in Classroom Style Choice

Alan S. Cummings (presenter, undergraduate student, acummings9@student.gsu.edu)

**Undergraduate Student Poster**

John M. Aiken (graduate student, jaiken1@student.gsu.edu)

Brian D. Thoms (corresponding author, bthoms@gsu.edu, 404-413-6045)

Georgia State University, Department of Physics and Astronomy, P.O. Box 4106, Atlanta, GA 30302-4106

Georgia State University teaches introductory algebra-based physics in two formats, a traditional lecture with separate laboratory and an integrated lecture-lab in the style of the Student Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) developed at NCSU. Differences are observed in characteristics of the students in the two formats, for instance physics pre-knowledge, major, gender, and race/ethnicity. Students may weigh a number of course factors to make their decision including class schedule, perceptions of the instructor, and classroom style (lecture or SCALE-UP). We hypothesize that the key underlying factors in student course selection are their expectations for learning and confidence in their abilities to perform in a college level physics class. We intend to measure the effect of their self-efficacy on classroom choice using interviews and a survey to develop a cognitive decision-making model.

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## Charge Mobility in Organic Thin-film Transistors Fabricated by Spray Deposition

Claire McLellan, Wake Forest University, Society of Physics Students, mcleca8@wfu.edu

**Undergraduate Student Poster**

Claire McLellan[1,2], Jack Owen[1,2], Natalia A. Azarova[1,2], Marsha A. Grimminger[3], Eric K. Chapman[1,2], John E. Anthony[3], Oana D. Jurchescu[1,2].

Spray deposition provides a simple and efficient fabrication method that is compatible with large-area processing and room temperature, ambient pressure conditions. Spray deposition method allows for applications that are impossible with present technologies, such as electronic paper, flexible displays, and wearable electronics. We report on spray-deposited 2,8-difluoro-5,11-bis (triethylsilylethynyl) anthradithiophene transistors with mobilities of 0.2cm$^2$/Vs, and on/off ratios of $10^7$. Devices were fabricated using a chlorobenzene solution on a silicon gate, silicon dioxide gate dielectric, and self-assembly monolayer treated gold source and drain contacts. By studying transfer characteristics from forward and backward gate voltage sweeps, we determine mobilities of charge carriers and the performance of the devices made by a deposition method. The effect of channel length and width on mobility is also studied.

[1]Department of Physics, Wake Forest University, Winston-Salem, NC
[2] Center for Nanotechnology and Molecular Materials, Wake Forest University, Winston-Salem,

NC
[3] Department of Chemistry, University of Kentucky, Lexington, KY

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## Teaching Radioactivity in the Introductory Modern Physics Class Designed for Life Science Majors

Kanesha Smiley, Marissa Lowe, Susie Brandstetter, Clayton State University, 2000 Clayton State Blvd, Morrow, GA 30240, 678-466-4783, Fax: 678-466-4797, TatianaKrivosheev@mail.clayton.edu

**Undergraduate Student Poster**

We present our experience of designing the hand-on activities on radioactivity, dosimetry, and biological effects of radiation in the Introductory Modern Physics class designed for Life Majors. The activities enhance the understanding of physics while boosting interest and relating to the students' previous knowledge and skills from Biology and Microbiology classes.
Equipment needed: none, this is a poster by undergraduate students

**Robinson Hall Lobby**

## Doppler Effect Experiment for Introductory Physics

Colin McGuire and Aaron Titus, High Point University, 833 Montlieu Ave, High Point, NC 27262,Colin McGuire <mcguic08@highpoint.edu>, Aaron Titus <atitus@highpoint.edu>

**Undergraduate Student Poster**

In introductory physics, the Doppler Effect is often demonstrated and simulated but is typically not investigated experimentally in the laboratory. In this project, an apparatus was constructed for an introductory physics lab on the Doppler Effect. A circuit composed of a transistor and LRC circuit was connected to a small speaker via a transformer to produce a periodic sound. The circuit and speaker were mounted on a cart. The cart's velocity was measured using a photogate, and the sound was measured with a microphone. A FFT was used to determine the frequencies in the spectrum. Even for fairly small velocities of the cart, the Doppler shift in frequency can be accurately measured. The apparatus can be used to investigate the Doppler shift of a moving source, a moving detector, or both. The apparatus and experimental results will be presented.