MEETING GUIDE
2009 Spring Meeting

Colorado/Wyoming Section
of the
American Association of Physics Teachers

and the

Society of Physics Students Zone 14

Colorado School of Mines
Golden, CO 80401
April 17-18, 2009
Welcome Fellow Physicists!

On behalf of the Executive Board of the CO/WY Section AAPT, and as Faculty Advisor to the Colorado School of Mines SPS Chapter, I would like to encourage you to join physics colleagues from across the greater Colorado and Wyoming regions for a full weekend of learning, sharing, and experiencing hands-on physics. Our program invites teachers at all levels – high school, two- and four-year college, and university ranks – to contribute a paper, present a poster, or just enjoy the invited talks, sessions, and workshops. This meeting is being held in conjunction with the SPS Zone 14 Meeting, so undergraduate and graduate students will have the opportunity to interact effortlessly with their peers and faculty mentors from various institutions.

We’ll start our engines on Friday afternoon with a field trip to the home of car No. 78 and the Furniture Row NASCAR Garage. Witness firsthand restrictor plates, horsepower limits, and burning rubber. After the field trip, we’ll return to the Mines campus for a barbecue dinner. On Friday evening, Diandra Leslie-Pelecky from the physics department at the University of Texas at Dallas will keep our engines tuned with an invited talk called “NASCAR: The Science Behind the Speed”, illustrating how basic scientific principles can be used to appreciate one of America’s most popular sports. After Diandra’s talk, we’ll have an ice cream social. All interested SPS members will then head across campus to the Golden Bowl for an evening of spirited bowling.

Sam Sampere, Physics Instructional Lab Manager at Syracuse University and a leader of the AAPT Summer Meeting’s Lecture Demonstrations Workshop, will begin our Saturday morning with an overview of the PIRA 200 (200 demonstrations organized by the Physics Instructional Resource Association that professionals believe to be essential in teaching about the most common physics phenomena). Sam will also perform his favorite demos from all areas of physics. After a short break, we’ll have a series of contributed paper presentations open to all students and faculty who wish to present. All reasonable topics are welcome. Students are encouraged to present summaries of undergraduate research projects, summer internships, senior design projects, as well as graduate student thesis or dissertation research. Technical papers from physics faculty and staff are also welcome that address best teaching practices, physics education research, introductory and advanced lab techniques, pedagogical studies, and all varieties of topical physics research.

A pair of workshops is scheduled after lunch. Brian Jones, the Director of “The Little Shop of Physics” at Colorado State University in Fort Collins, will provide everyone with an overview of his “Little Shop of Physics” science outreach program, then lead a workshop for both teachers and SPS members that wish to learn more about hands-on science education outreach. Diandra Leslie-Pelecky will keep her motor running on Saturday, too, and present a workshop called “Building SPEED – Science Participation: Education, Engagement, & Diversity” that will run concurrently with Brian's workshop. Both Brian's workshop and Diandra's workshop will feature numerous “make-and-take” activities that will provide attendees with ready-to-use demonstrations for their classes.

After these workshops, Mark Santee from the W. H. Freeman publishing company will deliver a special presentation on a new, multi-option solution that integrates an eBook, a full-color bound paperback textbook, plus WebAssign Premium, the leading online homework system. The DynamicBook™ solution is now available for Freeman’s widely adopted introductory physics textbook, Physics for Scientists and Engineers written by Paul A. Tipler and Gene Mosca. The SPS Zone 14 students will hold their business meeting in parallel with this presentation, focusing on a number of agenda items that will establish stronger ties with local SPS Chapters and the SPS National Office. To provide a fitting chronicle to our weekend, the Four Corners Section of the American Physical Society will present monetary awards for the Best Overall Student Paper, the Most Unique / Creative Student Paper, and the Best Student Pedagogical Paper. Afterwards, the SPS Chapter at the Colorado School of Mines will be sponsoring a Lecture Demonstrations Contest. At the end of the contest, all of the demos will be given away as door prizes, with preference to those teachers that serve our high schools. As time permits, we may even play a few rounds of Physics Jeopardy.

Here’s to a great weekend at the Colorado School of Mines, one full of physics fun and sharing!

Chuck Stone
Program Host and Chair
# Program Highlights

**Friday April 17, 2009**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>4:00 pm</td>
<td>Registration begins</td>
<td>South lobby, 1st floor of CTLM</td>
</tr>
<tr>
<td>4:30 pm</td>
<td>Cars depart Mines for field trip to NASCAR Garage</td>
<td>South lobby, 1st floor of CTLM</td>
</tr>
<tr>
<td>4:30 pm - 5:00 pm</td>
<td>Carpool caravan to NASCAR Garage</td>
<td>Various cars</td>
</tr>
</tbody>
</table>
| 5:00 pm - 6:00 pm | Tour NASCAR Garage                                                     | Furniture Row NASCAR Garage 4000 Forest Street  
                       | Contact person at garage: John Parks  
                       | (303) 322-2008                                                        |
| 6:00 pm - 6:30 pm | Registration continues                                                 | South lobby, 1st floor of CTLM                                           |
| 6:30 pm - 7:30 pm | Barbecue Dinner                                                        | On patio in front of CTLM 102                                             |
| 7:30 pm - 8:30 pm | “NASCAR: The Science Behind the Speed”                                  | CTLM 102  
                       | Diandra Leslie-Pelecky, Professor of Physics  
                       | The University of Texas at Dallas                                 |
| 8:30 pm - 9:00 pm | Ice Cream Social                                                        | On patio in front of CTLM 102                                             |
| 9:00 pm - Midnight | SPS Bowling                                                            | Golden Bowl  
                       | 525 24th Street  
                       | Golden, CO 80401                                                   |

**Saturday April 18, 2009**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
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<tbody>
<tr>
<td>7:30 am</td>
<td>Registration begins</td>
<td>South lobby, 1st floor of CTLM</td>
</tr>
<tr>
<td>7:50 am - 8:00 am</td>
<td>Welcome, Introductions, and Itinerary</td>
<td>CTLM 102</td>
</tr>
</tbody>
</table>
| 8:00 am - 9:30 am | “PIRA 200, TAP-L, and My Favorite Lecture Demos”                         | CTLM 102  
                       | Sam Sampere, Physics Instructional Lab Manager  
                       | Syracuse University                                                   |
| 9:30 am - 10:00 am | Refreshment Break & Time for Presenters to Setup                        | Berthoud Hall  
                       | • Between rooms 106 & 108  
                       | • Between rooms 241 & 243                                            |
| 10:00 am - 11:30 am | Contributed Paper Presentations                                          | Berthoud Hall  
                       | • Rooms 106, 108, 241, 243                                           |
| 11:30 am - 1:00 pm | Lunch                                                                   | Slate Café  
                       | 2nd floor of the Student Center                                       |
| 12:00 pm - 1:00 pm | **Business Meeting for the CO/WY Section AAPT**                         | Berthoud Hall 126  
                       | 0.20 CEUs Available  
                       | AAPT = $5.00, $6.00 otherwise                                        |
| 1:00 pm - 3:00 pm | Workshop: “The Little Shop of Physics”  
                      | Brian Jones, Professor & Director of “The Little Shop”  
                      | Colorado State University in Fort Collins  
                      | Workshop: “Building SPEED – Science Participation:  
                      | Education, Engagement, & Diversity”  
                      | Diandra Leslie-Pelecky  
                      | The University of Texas at Dallas                                   |
| 3:00 pm - 4:00 pm | Special Presentation: The DynamicBook™ Solution  
                      | Berthoud Hall 241                                                      |
| 4:00 pm - 4:05 pm | Student Paper Competition Awards                                          | Berthoud Hall 241                                                      |
| 4:05 pm - 5:00 pm | SPS Lecture Demos Contest and/or Physics Jeopardy                        | Berthoud Hall 241                                                      |
Field Trips, Great Food, Invited Talks, and Workshops

Friday April 17, 2009

4:30 pm - 6:30 pm = Field Trip to the Furniture Row NASCAR Garage
Join Professor Diandra Leslie-Pelecky, the author of *The Physics of NASCAR*, for an under-the-hood and behind-the-scenes scientific look at car No. 78 that races weekly on the NASCAR circuit. Located in Denver, the Furniture Row group is the only NASCAR Sprint Cup team headquartered west of the Mississippi River.

NOTE: You will want to depart Mines by 4:30 pm for the field trip to the garage. The tour will run from 5:00 pm to 6:00 pm, then we will return to the Mines campus by 6:30 pm. You are welcome to join the 4:30 pm caravan at Mines, or simply meet at the garage at 5:00 pm. The “Program Highlights” section lists the address.

6:30 pm - 7:30 pm = Barbecue Dinner
Master chef Shay Robinson will oversee a grill that will tantalize the palates of meat lovers and vegetarians.

7:30 pm - 8:30 pm = Invited Talk “NASCAR: The Science Behind the Speed”
Diandra Leslie-Pelecky, Professor of Physics
The University of Texas at Dallas

A group of racecars piloted by the best drivers in NASCAR are turning a corner. Without warning, one of the cars suddenly hits the outside wall. There were no engine failures, no flat tires, and none of the cars touched. So what happened? This is the question that sparked physics professor Diandra Leslie-Pelecky’s interest in the science of NASCAR. What she thought would be a ten-minute search of the web turned into a book, *The Physics of NASCAR*, which takes NASCAR (and science) fans behind the scenes at top race shops, onto the asphalt at Texas Motor Speedway, and into the garage with the Gillett Evernham Motorsports’ No. 19 car and its crew. Her talk guides the audience through an understanding of what it takes to make racecars faster and safer, and why driving a stock car is much harder than one might think. Diandra’s talk is filled with examples of current NASCAR science, including why drivers seem to be asking their crew chiefs to help them to get their cars to turn better, how SAFER (Steel and Foam Energy Reduction) barriers revolutionized track safety, why designing tires for the “new car” is such a challenge, and how something as simple as leaving an oil-tank lid slightly askew could lead to a competitive advantage. Her popular website, [www.stockcarscience.com](http://www.stockcarscience.com), includes weekly entries about topical science-related happenings in NASCAR.

8:30 pm - 9:00 pm = Ice Cream Social
Let your imagination and diet run wild with a selection of various ice cream delicacies!

9:00 pm - Midnight = SPS Bowling
Take a roll at ten pins, with lanes that have automatic scoring machines. Go for a “turkey” and a “sombrero”.

Page 5 of 22
Saturday April 18, 2009

8:00 am - 9:30 am = Invited Talk “PIRA 200, TAP-L, and My Favorite Lecture Demos”  0.20 CEUs Available
Sam Sampere, Physics Instructional Lab Manager  Syracuse University

Sam Sampere will start Saturday off with a trio of resources that teachers at all levels will find useful. As one of the leaders of the AAPT Summer Meeting’s Lecture Demonstrations Workshop, Sam will begin with an overview of the PIRA 200 (200 demos organized by the Physics Instructional Resource Association that professionals believe to be essential in teaching about the most common physics phenomena). He will then discuss the value of TAP-L, a listserv created for the purpose of discussing various topics related to Teaching APparatus (TAP) (meaning demo or lab equipment). TAP-L is housed at North Carolina State University and is primarily, but not exclusively, for the college physics settings. The people who usually subscribe to TAP-L are professionals who engage at various times in designing, purchasing, setting up, organizing, creating, performing, and cleaning up after various demonstrations of physical phenomena. Sam will also perform his favorite demos from all areas of physics.

11:30 am - 1:00 pm = Lunch and Business Meeting for the CO/WY Section AAPT
Enjoy all-you-can-eat grub at the Slate Café complete with meat and vegetarian options. Discuss business with the CO/WY Section Officers, and volunteer to host the next CO/WY Section Meeting at your institution.

1:00 pm - 3:00 pm = Workshop “The Little Shop of Physics”  0.20 CEUs Available
Brian Jones, Professor & Director of “The Little Shop of Physics”  Colorado State University in Fort Collins

Brian Jones will provide everyone with an overview of his “Little Shop of Physics” science outreach program, then lead a workshop for both teachers and SPS members that wish to learn more about hands-on science education outreach. This workshop will feature numerous “make-and-take” activities that will provide attendees with ready-to-use demonstrations for their classes. For details see http://littleshop.physics.colostate.edu/

1:00 pm - 3:00 pm = Workshop “Building SPEED – Science Participation: Education, Engagement, & Diversity”  0.20 CEUs Available
Diandra Leslie-Pelecky, Professor of Physics  The University of Texas at Dallas

Diandra Leslie-Pelecky is nationally recognized for her work in science education at all levels. She has worked extensively with K-12 schools, future science teachers, and the public, focusing on teaching methods that help students understand that science is a process by which to understand the world, not a collection of facts to be memorized. In this workshop, Diandra will provide the audience with a number of “make-and-take” activities that will illustrate how principles of auto racing can be used to address statewide science standards. Her educational materials on the science of motorsports for middle schools and high schools can be found at www.buildingspeed.org

3:00 pm - 4:00 pm = Special Presentation: The DynamicBook™ Solution  W. H. Freeman and Company
Mark Santee

W. H. Freeman has introduced a new, multi-option solution that integrates an eBook, a full-color bound paperback textbook, plus WebAssign Premium, the leading online homework system. The DynamicBook™ solution is now available for W. H. Freeman’s widely adopted introductory physics textbook, Physics for Scientists and Engineers written by Paul A. Tipler and Gene Mosca.
The Four Corners Section has a strong commitment to support the work of physics students and to give them opportunities to present their research and to meet physicists in our region. To that end, the Section offers small, regional meetings of limited expense and activities that can reach more APS members and potential members, including students and industry physicists.

Geographically the Four Corners Section includes the states of Arizona, Colorado, New Mexico, and Utah. Four Corners is the point of orthogonal intersection of the borders of these four states, the only point common to four states in the United States.

Section meetings will unite participants from colleges, universities, industry, and government laboratories. In addition, the Four Corners Section contributes to a greater awareness of regional activities in physics through its website and its public outreach programs.

Next 4CS-APS Meeting
Fall 2009 Meeting of the 4CS-APS
Colorado School of Mines
Golden, CO 80401
October 23-24, 2009

BALLOT: Student Paper Competition

Voting Instructions: For each Award, write the name of the Student Presenter that you feel best embraces the aspects that each award addresses. On a scale of 1 (poor) to 10 (excellent), circle the score that quantifies your choice. When done, tear off the bottom portion of this sheet at the dashed line and hand it to one of the Session Presiders before lunch on Saturday.

<table>
<thead>
<tr>
<th>Award</th>
<th>Student Presenter</th>
<th>Circle Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Overall Student Paper ($50)</td>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Most Unique / Creative Student Paper ($25)</td>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Best Student Pedagogical Paper ($25)</td>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>
## Contributed Paper Presentations: At a Glance

<table>
<thead>
<tr>
<th>Time</th>
<th>Berthoud Hall 106 Todd Ruskell Session A</th>
<th>Berthoud Hall 108 Pat Kohl Session B</th>
<th>Berthoud Hall 241 Jim McNeil Session C</th>
<th>Berthoud Hall 243 Vince Kuo Session D</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 am to 10:15 am</td>
<td>A-1. Time-Dependent Modeling of Fast Wave Absorption with Multiple Damping Mechanisms</td>
<td>B-1. GPS Timing for the Pierre Auger Observatory</td>
<td>C-1. Adapting Peer-Tutoring to an Online Format</td>
<td>D-1. A Dozen Uses for Your Dead Christmas Tree Lights</td>
</tr>
<tr>
<td>10:45 am to 11:00 am</td>
<td>A-4. Estimation and Tracking: Where It Wasn’t</td>
<td>B-4. Design and Implementation of a Muon Lifetime Experiment</td>
<td>C-4. Means to Scientifically Inform the General Public</td>
<td>D-4. Amateur High-Powered Rocketry</td>
</tr>
</tbody>
</table>
Session A: Berthoud Hall 106  
Presider: Todd Ruskell – Colorado School of Mines

10:00 am – 10:15 am  
A-1. Time-Dependent Modeling of Fast Wave Absorption with Multiple Damping Mechanisms
Presenter: Walter Unglaub (student)  
Institution: Colorado School of Mines  
Address: 6907 Palace Drive  Colorado Springs, CO 80918  
Phone: (719) 640-7197  
Email: wunglaub@mines.edu

Plasma response to absorption of Fast Wave (FW) power is studied in a time-dependent model in the presence of multiple damping mechanisms, including direct electron absorption and ion cyclotron harmonic damping in the core, and an unspecified edge loss mechanism. Previous work on the plasma response to a step in FW power in a slab model [Ref. 1] is extended to take into account additional effects such as the density rise with FW injection and confinement degradation with increased heating power. To extend this work to an axisymmetric toroidal equilibrium, we couple the GENRAY ray-tracing code to the ONETWO transport code. In both models, it is found that the final partitioning of power among the various damping mechanisms and the time needed to reach the final state strongly depend on initial conditions. The time required to reach the steady-state can be many energy confinement times.


10:15 am – 10:30 am  
A-2. The Dynamics of a Bubble Rising through a Fluid
Presenter: Clint Shelley (student)  
Institution: Mesa State College  
Address: 1730 North 7th Street, #2  Grand Junction, CO 81501  
Phone: (970) 985-9905  
Email: cshelley999@gmail.com

At first glimpse, an air bubble rising through a fluid might appear to be a simple physical process. Using simplifications such as a constant volume for the bubble yields a solvable linear differential equation describing the bubble’s dynamics. However, complications can arise from the buoyant and drag forces acting on the bubble. Once the volume is allowed to vary as a function of depth and when a drag force proportional the speed and size of the bubble are considered, we arrive at a second-order, non-linear differential equation. By applying numerical techniques, we explore the behavior of this more sophisticated model and compare it to the dynamics of the constant volume model.

10:30 am – 10:45 am  
A-3. Modeling Feshbach Resonance in Rb-85
Presenter: Chris Newby (student)  
Institution: Colorado School of Mines  
Address: 16547 West 11th Avenue  Golden, CO 80401  
Phone: (719) 359-3715  
Email: cnewby@mines.edu

The phenomenon of a Feshbach resonance has been viewed in Rb-85 and is now quite familiar. The purpose of this project is to analyze the phenomenon of a Feshbach resonance in momentum space and phenomenologically apply a simple model to the Rb-85 case to see if we can reproduce a resonance at 155 gauss. We used the Lippmann-Schwinger equation with separable potentials to find the scattering length, and used the Yamaguchi potential to model the potentials present in the Rb-85 atom. We found that only a slight modification to the data calculated for the Rb-85 atom was needed to accurately predict a Feshbach resonance at 155 gauss.
The goal of this science project was to build a sequential estimation filter that tracks a target. My hypothesis was that I could build such a filter and tune it to produce a smaller median error than the median of the distance between the measured position and actual position of the target. The objects tracked were constant velocity targets. I tuned my filter by experimenting with values of “g” and “h.” Initially, I estimated the target position or velocity. Using the estimate, I ran my program to create a prediction for the future target position. I then took a measurement (with small error) of the new target position. The new position measurement led to an updated estimate of the target position and velocity. This cycle was repeated, leading to a fairly accurate representation of the target path. I then completed the tuning process for different amounts of error, different trajectories, and different starting values for velocity and position.

Connie is a famous science fiction writer, winner of 10 Hugo Awards and 6 Nebula Awards. She will be inducted in the Science Fiction Hall of Fame in June 2009. She will discuss how science fiction writers get their ideas and use science in their work.

The purpose of this research was to test two hypotheses, which addressed the global dilemma of ocean acidification. It was first hypothesized that through the process of photosynthesis, the marine phytoplankton Nannochloropsis oculata, and the marine macroalgae Chaetomorpha spiralis, would be able to process excess carbon dioxide (CO$_2$) before it could form carbonic acid (H$_2$CO$_3$) which acidifies the water. It was next hypothesized that through the supplementation of ascorbic acid the calcification rates of the calciferous alga Halimeda monile and Udotea flabellum could be increased. To begin the first phase of experimentation a 210-Liter aquarium was partitioned into three 70-Liter compartments to which artificial seawater was added. Through a yeast based production source, CO$_2$ was added through airline tubing into the atmospheric area above the water level, and below the top of the compartment. The compartments were then sealed to prevent the escape of CO$_2$. When testing the effect of phytoplankton on the pH, either 1 mL of N. oculata phytoplankton was added for every 3 L of water in two compartments, or two equal sections of C. spiralis was added in two compartments. Bihourly pH and KH measurements were taken, and the CO$_2$ concentration in ppm was derived from this using the following formula:

$$3 \times KH(10^{(7-pH)}) = CO_2$$

It was found that the average pH of the compartment supplemented with CO$_2$, but without photosynthetic organisms, was 7.17. The compartment with CO$_2$ that contained photosynthetic organisms had an average pH of 7.94. This confirmed my hypothesis that photosynthetic life would be able to process excess CO$_2$, and keep the pH higher. When testing the second hypothesis, the pH of two compartments were lowered to 7.9, and specimens of H. monile, and U. flabellum were added to each compartment. To one of the compartments with a pH of 7.9, 0.2 mL of ascorbic acid was supplemented per 10 L of water. Every 12 hours a calcium titration was performed to observe calcium uptake, and also pH and KH levels were tested. The results of this experiment confirmed my hypothesis that ascorbic acid supplementation increased calcification, with the algae in a supplemented compartment using 105 ppm of calcium in the process of calcification. The algae in the unsupplemented aquarium used 30 ppm. This showed that ascorbic acid increased the rate of calcification by 3.5 times.
The Pierre Auger Observatory has developed a new stand-alone computing unit called the GPSY2 which acts as a controller for the detection system at the observatory. The GPSY2 uses the Global Positioning System (GPS) to provide standardized time and position measurements at each of the observatory's water tank detectors. The detectors are stand-alone systems, and must use the GPS to synchronize time across the network of detectors. To test the GPSY2, we used different input clocks, including a quartz oscillator (GPSY1), a rubidium oscillator, and the NIST standard time. We've found the GPSY2 to have an accuracy of about 20 ns from true time.

In the world of ever smaller and faster computers, quantum mechanics represents a valuable resource to information processing. This talk is an introduction to the basics of quantum computing, covering many of the basic principles, ideas, and terminology of quantum information processing, including some of the physical resources needed for a quantum computer and how logic operations would be performed in such a system. Universality of quantum gate sets, and the decomposition of any given quantum operation into such universal sets, is discussed. Finally, the application of quantum information processing to problems such as superdense coding and quantum teleportation will be considered.

We discuss a quantum lattice gas approach for numerically solving the Maxwell equations on a quantum processor. We cast the equations of classical electromagnetism in Dirac form, and then show how this can provide the basis for numerical solution. The resulting algorithms [Ref. 1] contain a combination of collision and shift operators and are well suited to parallelization. The accuracy relative to the time step may be systematically increased. We illustrate several theoretical techniques – not only matrix exponentiation, but how to exponentiate partial derivative operators.

Every minute, one muon per square centimeter strikes the Earth’s surface. They are products of high-energy cosmic radiation from outer space interacting with the upper atmosphere. Muons are short-lived, existing an average of just over 2 millionths of a second before decaying into an electron and neutrinos.

For our Senior Design Project, we constructed an experiment to measure the muon lifetime. We then implemented it as an experiment for a junior-level nuclear physics laboratory course. Following guidelines that we created, students configured the apparatus, collected data, and determined the muon lifetime from the data. Generally, the students seemed to sufficiently understand the physics of the measurement process and usually obtained results to within 5% of the true value. Improved guidelines are needed to further assist students with the error analysis.

Potentially, the least expensive route to clean solar-generated electricity is the development of large-scale, efficient, solution-processed organic photovoltaic devices. This talk will cover two topics. First presented is ultrasonic spray as a method for deposition of the bulk heterojunction layer in organic solar cells. We have optimized deposition parameters for ultrasonic spray in air and reached power conversion efficiencies up to 2.8%. X-ray diffraction and time-of-flight comparisons of pristine conjugated polymer films indicate structure and mobilities of sprayed films equivalent to drop-cast films. After transferring this deposition system into an inert atmosphere and using the same deposition parameters we have fabricated organic solar cells with power conversion efficiencies up to 3.2%. Second, we present a series of investigations for several surface preparations on a critical component of organic solar cells, indium tin oxide, using cyclic voltammetry, work function, and contact angle measurements. Surface treatments are correlated with device results in a prototypical organic photovoltaic architecture with an eye toward enhanced charge transfer and material stability at the metal-oxide/organic interface. Included is an overview of main organic photovoltaic operation and degradation mechanisms in the context of surface modification studies as well as processing.

Nanoparticles are being used in an ever-expanding number of industries – electronics, pharmaceuticals, and energy, just to name a few. A 2001 National Science Foundation report *Societal Implications of Nanoscience and Nanotechnology* [Ref. 1] projected that as many as 2 million workers may be needed to support nanotechnology industries worldwide within 15 years. Clearly we stand at a juncture, or even in the midst, of an industrial revolution. Now that nanotechnology has arrived, how do we prepare and educate our future workforce?

The NanoLeap project has broken new ground by developing and evaluating instructional materials that teach high school students about nanoscience. The inquiry-based curriculum modules entitled *A NanoLeap into New Science* include student activities, experiments, and assessments for use as replacement units in high school physical science and chemistry courses. Accompanying resources and professional development for educators are included to facilitate implementation. Findings from the modules’ extensive field-testing will be discussed.

This work is supported by the National Science Foundation, Division of Elementary, Secondary, and Informal Education, award # ESI-0426401.

10:00 am – 10:15 am  
C-1. Adapting Peer-Tutoring to an Online Format  
Presenter: Thomas E. Furtak  
Co-authors: Joanna C. Dunlap (University of Colorado Denver) and Susan A. Tucker (E & D Associates)  
Institution: Colorado School of Mines  
Address: 1523 Illinois Street Golden, CO 80401  
Phone: (303) 273-3843  
Email: tfurtak@mines.edu  

The development of ConcepTests (clicker exercises) has provided classroom instructors with a powerful tool for helping students to stay actively involved in a lecture. An essential part of the method is peer-tutoring, when students defend their answers in discussions with their classmates. It would be desirable to adapt this teaching strategy to an online learning environment. However, the social interaction compromises flexibility and is difficult to manage over a network. We have developed a method of simulating the social interaction feature of a ConcepTest. Students justify their answers with a short sentence, and are then presented with a gallery of similar responses selected from a database of previously collected justifications. Trials of the materials have shown that students learn as effectively through the online ConcepTests and have positive reactions to the virtual peer-tutoring experience. – *Sponsored by the U. S. Department of Education (FIPSE) and the Colorado School of Mines*

10:15 am – 10:30 am  
C-2. Toying Around With the Wii Smoothboard  
Presenter: Courtney Willis  
Institution: University of Northern Colorado  
Address: 1716 13th Avenue Greeley, CO 80631  
Phone: (970) 353-2079  
Email: courtney.willis@unco.edu  

About a year ago a graduate student at Carnegie Mellon University came up with an interesting idea to use the Nintendo Wii to make a classroom Smartboard. This has become very popular with teachers, and a number of others have improved on the original idea. The software is free, the materials are inexpensive, and the uses are unlimited. The Wii Smoothboard will be demonstrated with examples of what can be done in a real classroom.

10:30 am – 10:45 am  
C-3. Birds On a Wire  
Presenter: Jacob Cady (student)  
Institution: Mesa State College  
Address: 1100 North Avenue Grand Junction, CO 81501  
Phone: (970) 210-8631  
Email: jlcady@mesastate.edu  

Consider two separate tracks of equal horizontal distances and initial and final heights. One track remains at this initial height while the other angles down, levels out, and then angles back up in order to regain its original height. If two identical balls are set rolling with equal initial speeds, which ball completes the track in a shorter time interval?  

In this project, the dynamics of each ball are analyzed using basic Newtonian mechanics. We calculate the time necessary to complete each path in terms of the parameters of the track and the initial velocities of the balls. We derive an expression for the time difference of the two tracks and compare this to data taken on a pair of tracks built as a senior project. We find good agreement with our theoretical prediction.
**10:45 am – 11:00 am**  
**C-4. Means to Scientifically Inform the General Public**  
Presenter: Anne Andrew (student)  
Institution: University of Colorado Denver  
Address: 1039 South Parker Road, #A-12 Denver, CO 80231  
Phone: (303) 990-4961  
Email: Anne.Andrew@email.ucdenver.edu

Scientific misinformation is the result of several different areas of modern society. It is the responsibility of scientists to correct these areas in public knowledge. I am currently working on three projects to help correct these misunderstandings. In August 2008, I started the Space Society of Auraria (SSA), a club on the Auraria Campus for anyone who wishes to participate. The SSA promotes the correction of misinformation and holds events to teach current scientific understandings to the general student body. As of October 2008 I have been teaching a class at the Colorado Free University, the local adult education center. This class teaches overviews of astronomy, geology, and neurology in an interactive lecture format. My current project is an hour long video on astronomy to submit to Denver Open Media, Denver’s public access channel (Comcast 56 and 57).

**11:00 am – 11:15 am**  
**C-5. Real-Time Assessment of Problem-Solving Strategies of Physics Students using Tablet PC’s & InkSurvey**  
Presenters: Tolga Gok and Frank Kowalski  
Institution: Colorado School of Mines  
Address: 1523 Illinois Street Golden, CO 80401  
Phone: (303) 273-3845  
Email: tgok@mines.edu and fkowalsk@mines.edu

A problem solving strategy is taught using real-time formative assessment and the digital ink capability of tablet computers. Students submit answers to open format questions via a web browser. The instructor instantaneously receives the responses and can give the students immediate feedback. Results are presented on the effectiveness of this technique in influencing learning.

**11:15 am – 11:30 am**  
**C-6. Physics for Female Students in Tanzania, East Africa**  
Presenters: Frank Mathews and Jack Kintner  
Institution: Colorado School of Mines  
Address: 492 Mount Evans Road Golden, CO 80401  
Phone: (303) 526-2132  
Email: afmathews2@wispertel.net and jkintner@mines.edu

For the first time in the history of the Maasai Tribe, women are being encouraged to obtain an education. This paper offers glimpses into challenges and opportunities encountered in establishing (from scratch) the science lab components of an all-girl six-year high school and junior college one year at a time. Ebenezer Girls School in Arusha does not yet have a library or internet. They have very few textbooks, zero science equipment, and a curriculum mandated by a moribund Department of Education patterned after the British and German systems of colonial days. BUT THEY HAVE ALMOST 300 BEAUTIFUL MAASAI GIRLS EAGER TO LEARN!
Session D: Berthoud Hall 243
Presider: Vince Kuo – Colorado School of Mines

10:00 am – 10:15 am
D-1. A Dozen Uses for Your Dead Christmas Tree Lights
Presenter: J. D. Birchmeier
Institution: Divine Child High School
Address: 829 Olympia Avenue   Longmont, CO 80501
Phone:   (303) 772-4030
Email: jdbirchmeier@yahoo.com

Since the weather is getting warmer, it’s about time to take the Christmas Tree lights down! Since half of them are dead by now, and Colorado is very into recycling – here’s a few uses for the strings in your science class. At no extra charge, if I can find my “sniffer”, I’ll show you how to find the one dead light in a string quickly and easily! You’ll learn the circuit diagrams, voltages, and resistances of your lights, how to demonstrate a variable resistor easily, uses for pieces of dead light strings, how to make your own “sniffer” for AC fields (don't worry, it works on DC, too). Total cost for all of these demonstrations is as close to zero as possible.

10:15 am – 10:30 am
D-2. Testing of a Theoretical Model for a Terrain Park
Presenter: John Smith (student)
Institution: Colorado School of Mines
Address: 2011 Infinity Circle, #175   Golden, CO 80401
Phone:   (720) 217-6972
Email: johsmith@mines.edu

Over the last few decades terrain parks have become staples at most major ski resorts. However, very little has been done to improve their safety and as riders have gotten better, jumps have gotten bigger. Skiing and snowboarding are dangerous sports and, while some injuries are inevitable, many jumps are designed poorly. Unfortunately, most park designers are forced to rely only on their experience when designing jumps. This presentation contains the testing and development of a theoretical model for use in future park designs. The model accounts for friction along a slide path, center of mass correction to account for a jump at takeoff, rudimentary air, and speed checks prior to takeoff. To test the model, film of a rider was analyzed using VideoPoint. Parallax and lens distortion effects were taken into account and several body parts were tracked to account for the rider's center of mass.

10:30 am – 10:45 am
D-3. Injury Risk upon Impact for Terrain Park Snowboard Jumping
Presenter: Travis Michelle Nokes (student)
Institution: Colorado School of Mines
Address: 467 Somerset Drive   Golden, CO 80401
Phone:   (303) 587-2968
Email: tnnokes@mines.edu

It is widely acknowledged that winter terrain parks pose a significant hazard to their snowboarding patrons. In an accompanying study, a dynamical analysis of the snowboarder allows one to predict the landing impact expressed in an equivalent vertical height. In this work, I extend that result to analyze the potential for injury using a simulation model of the human body designed specifically for this project using Working Model 2D. I analyzed high-speed video of body compression during landings, and used the resulting data to fix the parameters of the model and validate its realistic behavior. This allowed me to simulate knee and ankle motion to find peak accelerations during impacts from varying heights. By comparing the calculated accelerations to published tolerance values for the human body, I have been able to determine under which conditions injury to the knee or ankle is likely to occur.
10:45 am – 11:00 am
D-4. Amateur High-Powered Rocketry
Presenter: Jonathan Kintner (student)
Co-author: Brad McGarvey
Institution: Colorado School of Mines
Address: 6130 Pierce Street Arvada, CO 80003
Phone: (720) 898-5663
Email: jokintne@mines.edu

There are many aspects that go into building a rocket, from propulsion to the aerodynamics of the rocket. Some amateur high-powered rockets are capable of flying as high as 90,000 feet and sustaining speeds of Mach 3. Some amateurs build their own rocket motors as well. As a result, there is a lot of work that is put into the design of these types of rockets. Some of the design issues these amateurs must consider when making their rockets range from the types of materials they will use, propellant formulations, and flight data recording devices that can track telemetry in real time.

11:00 am – 11:15 am
D-5. Connecting the Classroom to the Race Track
Presenter: Bruce Pearson
Institution: Jefferson High School
Positive S.P.I.N. Foundation / Thunder Kids Motorsports Education and Diversity Program
Address: 2305 Pierce Street Edgewater, CO 80214
Phone: (720) 252-0866
Email: bpearson@jeffco.k12.co.us

Thunder Kids Motorsports Education and Diversity Program is reaching out to at-risk youth through auto racing in an environment that develops the connection between their education and real-world applications of classroom material. By providing an opportunity for students to become involved with a local NASCAR racing team, the program also has the goal of providing teachers unique tools that help keep students motivated and excited about learning. Students will apply principles of math and physics to race cars that they will work on and possibly have the chance to drive at Colorado National Speedway in Dacono, Colorado. Other students will apply these principles to radio-controlled cars. Both “teams” will have other students develop their marketing skills to promote the teams. Based at Jefferson High in Edgewater, Colorado, the program has the goal to develop the program in schools throughout Colorado. Founder Bruce Pearson will explain the three-team format of the program.

11:15 am – 11:30 am
D-6. Understanding Physics in Motorsports
Presenter: Jaime Bubak (student)
Institution: Student – Ralston Valley High School
Address: 7478 Secrest Court Arvada, CO 80007
Phone: (303) 246-7405
Email: Outlawsprint9@isp.com

I am a seventeen year old female competing in motorsports, and I am also studying physics in my high school. I do not fully understand the physics in motorsports; however, for my physics final I am studying the lap times of a quarter midget race car and determining how it relates to the traction in a physics sense. So far in my study I have determined that the smoother the lines that are driven, the quicker the lap times. Due to the driver driving smoother lines the car is able to have better traction meaning the car is less likely to lose traction and spin out. I am eager to learn more about how the fascinating subject of physics is present in my favorite hobby of motorsports.
Colorado/Wyoming Section of the American Association of Physics Teachers
Business Meeting Agenda

Saturday April 18, 2009
12:00 pm - 1:00 pm
Slate Café (2nd floor of the Student Center)

1. Approval of Previous Minutes

2. News and Announcements

3. Old Business
   A. Constitution/bylaws issues, particularly concerning the officer changes and numbers

4. New Business
   A. What value does the CO/WY Section have, and what does it offer its members?
   B. Discussion of membership dues or non-dues

5. Officers’ Reports
   A. President’s Report (J. D. Birchmeier, Divine Child High School)
      i. expand fall conference
      ii. continue to build membership
   B. Vice President’s Report (Brian Huang, Centaurus High School)
   C. Vice President’s Report (Chuck Stone, Colorado School of Mines)
   D. Secretary / Treasurer’s Report (Richard Krantz, Metropolitan State College of Denver)
   E. Section Representative’s Report (Don Cameron, Lakewood High School)

6. Election of New Officers

7. Selecting a date and host site for our next CO/WY Section AAPT Meeting

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MEETING NOTES
1. Welcome (Tim Lim, President of the Colorado School of Mines Society of Physics Students)

2. Zone Councilor’s Report (Professor Rudi Michalak, University of Wyoming)

3. Associate Zone Councilor’s Report (Sherry Orton, Mesa State College)

4. News from local SPS Chapters

5. Selecting a date and host site for our next Zone 14 Meeting
   A. Have any other schools already begun planning for the next Zone 14 Meeting?
   B. Do any schools wish to volunteer to host the next Zone 14 Meeting?
   C. Fall 2009 Meeting of the 4CS-APS (October 23-24, 2009 at CSM … have another Zone Mtg then?)

6. Fall 2009 Meeting of the 4CS-APS (October 23-24, 2009 at the Colorado School of Mines)

7. Building a Zone 14 website

8. Helping Zone 14 establish stronger ties with local SPS Chapters and the SPS National Office

9. Introductions of Associate Zone Councilor nominees
Special Presentation
Berthoud Hall 241

3:00 pm – 4:00 pm
The DynamicBook™ Solution
Presenter: Mark Santee
Institution: W. H. Freeman and Company
Address: 41 Madison Avenue New York, NY 10010
Phone: (973) 204-9111
Email: msantee@whfreeman.com

With the costs of higher education presenting even greater challenges for 21st century students, textbook publisher W. H. Freeman has introduced a new, multi-option solution that integrates an eBook, a full-color bound paperback textbook, plus WebAssign Premium, the leading online homework system. The DynamicBook™ solution is now available for W. H. Freeman’s widely adopted introductory physics textbook, Physics for Scientists and Engineers written by Paul A. Tipler and Gene Mosca.
*** SPECIAL THANKS ***

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Colorado/Wyoming Section of the American Association of Physics Teachers

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Dearborn Divine Child High School

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Centaurus High School

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Colorado School of Mines

Secretary/Treasurer: Richard J. Krantz krantzr@mscd.edu
Metropolitan State College of Denver

Section Representative: Don Cameron dcameron@jeffco.k12.co.us
Lakewood High School

Four Corners Section of the American Physical Society

Chair, 4CS-APS: William M. Fairbank, Jr. fairbank@lamar.colostate.edu
Colorado State University – Fort Collins, CO

Society of Physics Students Zone 14

Zone Councilor: Rudi Michalak rudim@uwyo.edu
University of Wyoming

Associate Zone Councilor: Sherry Orton sorton@mesastate.edu
Mesa State College

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