SESSION IV-2
12:10-12:25
Room 223

Title: Computer Simulations with Physics Content

Abstract:

How web based computer simulations can help students visualize and understand physics concepts. In teaching physics, we place large demands on our student's abilities to visualize interactions. The amount of cognitive load that student's are using to visualize these interactions increases the difficulty of understanding the underlying physics concepts. The extra cognitive load that student's use to visualize can be reduce by using computer simulations with physics content.

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Indiana Section of the
American Association
of Physics Teachers

SPRING MEETING
April 28, 2006
Registration: 5-6 p.m.
Supper: 6-7 p.m.
Demo Show: 7-8:30 p.m.
Open Sharing of Demos: 8:30-

April 29, 2006
Opening Remarks: 8:30 -8:45 a.m.
Sessions: 9:00 a.m. - 12:45 p.m.
Lunch: 12:30—1:30 p.m.
Business Meeting: 1:30-3:00 p.m.

Purdue University
Department of Physics
525 Northwestern Avenue
West Lafayette, IN 47907

SESSION I-1
9:00-9:15
Room 338

Title: Opportunities for High School Research on a Budget

Abstract:

This session is to introduce some of the student research opportunities that have been used at Crawfordsville High School. We currently work with Project Inspire, Radio Jove and PEPP. Project Inspire is using a kit built very low frequency radio receiver to monitor lightening generated signals. This year a student researched radio signals from Hurricanes Katrina and Rita. Radio Jove also uses a kit built receiver to monitor radio signals from Jupiter and the Sun. The Princeton Earth Physics Project allowed students to search for fault lines in western Indiana. Indiana University has developed a strong network in Indiana that allows students to work with local data. I will describe the programs and their expenses. Several of my students will present in separate sessions.

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Toronto in 1991, a master's degree in physics from the University of Victoria in 1993, and completed his doctoral thesis in astronomy at Boston University in 1998. Prior to coming to Purdue, he was a Caltech postdoctoral scholar at the Jet Propulsion Laboratory, and a Jansky Postdoctoral fellow at the National Radio Astronomy Observatory. He specializes in studying extremely high energy outflows from supermassive black holes using the world's most powerful radio telescopes. He is currently the head of a NSF-sponsored program to investigate the long term dynamics of these outflows, in order to better understand the physical processes that govern their creation and evolution at the centers of distant galaxies.

Contact info:

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SESSION I-3
9:40-9:55
Room 338

Title: Relationship Study of VLFs and Specific Weather Patterns

Abstract:

I began my study of VLFs by recording during two powerful hurricanes: Katrina and Rita. However, my recording led me to try to isolate the parameters that created these strong signals. I hypothesized that location was the dependent upon the amount of data. I then looked at the power of the Hurricanes and noticed that although Hurricane Katrina was far closer at a distance of 705-694 km as opposed to Hurricane Rita's distance of 1555-1550 km, Hurricane Rita produced far greater and more powerful data. I concluded then that location was least important when compared to strength of the hurricane in generating very low frequency radio signals. To make sure these signals were accurate, I decided to investigate the effect of outside influences such as lightening strikes and earthquakes. I have requested satellite detected lightening strike information from the Marshall Space Flight Center.

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SESSION III-7/8
11:10-11:45
Room 331

Title: Indiana High School Physics ECA Results 2005

Abstract:
Last spring we asked high school physics teachers present at the INAAPT meeting to voluntarily send the answer sheets from the new Indiana High School Physics End-of-Course Assessment, that they had already graded without student names, to Becky Carter or Mike Wolter for the purpose of doing an item analysis on the new test. Five teachers from five different schools representing a little over 250 high school physics students submitted answer sheets. This paper will describe the findings from that data, demonstrate how the data is interpreted, suggest changes to the exam, and propose a follow-up study for this year (2006).

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SESSION I-5

10:20-10:35
Room 338

Title: Design and Development of a Multi0Detector Array of PIN Diodes to Monitor Beam Uniformity in High-Energy Gamma-Ray Cancer Treatment Planning

Abstract:

In order to assess the uniformity of the radiation dose to Treatment large areas using high-energy gamma-rays, a one-dimensional linear array of 32 PIN diodes is used to simultaneously record gamma-ray intensity. The array maps treatment areas up to 40 cm in width. An electronic interface circuit acquires and transfers the output information of the array to the monitoring system. This electronic interface circuit consists of the following parts: (1) current-to-voltage converters and (2) an analogue switching and multiplexing system. The monitoring system utilizes LabVIEW, an external data acquisition module, and a computer to provide the real-time radiation intensity distribution graphs. Sample results will be presented to illustrate the operation of detector array.

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Biography:

Nicholas Giordano obtained his B.S. at Purdue University and his Ph.D. at Yale University. He has been on the faculty at Purdue since 1979, served as an Assistant Dean of Science from 2000-2003, and is currently the Hubert James Distinguished Professor of Physics. His research interests include electrical conduction, super-conductivity, and magnetism in ultra-small metallic structures, along with musical acoustics and the physics of the piano. Professor Giordano earned a Computational Science Education Award from the Department of Energy in 1997 and in 2004 was named Indiana Professor of the Year by the Carnegie Foundation for the Advancement of Teaching and the Council for the Advancement and Support of Education.

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SESSION I-7
11:10-11:25
Room 338

Title: Lessons Learned in a Unique General Physics Laboratory

Abstract:

We now have several years of experience teaching a unique general physics laboratory that focuses on D C circuits for the full spring semester. I will present the overall structure and rationale for the laboratory and then talk about some of our experiences and the lessons learned in teaching this laboratory.

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Bio:

Dr. Sergei Savikhin is currently an assistant professor in the Physics Department at Purdue University. He received his doctoral degree in Tartu University, Estonia. Prior to coming to Purdue he was a Scientist and Ames Laboratory. He specializes in ultrafast lasers and uses this technology combined with quantum mechanical modeling to perform experimental and model studies of various biological processes, including photosynthesis. His teaching experience includes lecturing undergraduate courses on electricity, magnetism, modern physics, and a newly developed course Integrative Science. He is a recipient of Ruth and Joel Spira award for outstanding teaching of physics.

Contact info:

Sergei Savikhin
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SESSION I-9
11:50-12:05
Room 338

Title: Student Preparation and Student Performance in a First-Semester Algebra-Based Physics Course

Abstract:

For several years course reforms and measures of improved student performance have been investigated in the two-semester algebra-based physics course. Pre- and post-tests using the FCI and course grades were used as measures of student performance. In addition information on high school preparation in physics and mathematics, student demographics (college major, classification, etc.), and student performance were used (1) to assess the effectiveness of new strategies implemented and (2) to measure student learning. Results will be presented that indicate high school physics preparation strongly correlates with performance.

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SESSION III
Room 331

SESSION II-3
9:40-9:55
Room 333

Title: Energy Bar Charts

Abstract:

In dynamics, the free-body diagram is perhaps the most important representation students use to apply the concepts embedded in Newton's Laws. In the study of energy, students may also benefit from the use of an appropriate representation to help them consistently apply the Law of Conservation of Energy. Energy bar charts are one such representation. These bar charts challenge students to think through energy problems conceptually first and also provide a mechanism for applying the appropriate equations needed for the solution. They are especially useful in situations when work is done on or by the system. This discussion follows the Energy Pie Charts presentation by Rob Spencer of West Lafayette Jr/Sr High School.

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SESSION II-4
10:00-10:15
Room 333

Title: Critical Thinking and Independent Learning in AP Physics Mechanics

Abstract:
This project seeks to improve the traditional approach to teaching high school physics by developing specific lesson plans incorporating modern ideas on active learning and critical thinking. One objective is to challenge the students' current interpretation of academic success and stretch them beyond regurgitation of facts and sequences. These alterations will be applied to a year long AP Physics C Mechanics curriculum. Lesson plans include strategies for comprehending technical textbooks, solving problems, analyzing information, communicating with peers and supervisors, and thinking critically. Some of the teaching techniques have come from developed innovations, such as Eric Mazur's Peer Instructions and Priscilla Laws' Workshop physics. In contrast to the passive, sponge-like mentality adopted by many high school physics students, these research-based lesson plans push the students into an active and independent learning mode that avoids the traditional lecture format.

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SESSION II-5
10:20-10:35
Room 333

Title: Santa's Sleigh Lab (or How to Show Students that

Forces are Fun!)

Abstract:

Physics students often ask, "Why do we need to learn this?" This lab shows, in an entertaining yet real way, that forces are busy at work in all aspects of life, even to help Santa deliver presents. Students become reindeer, elves, and Santa Clauses and travel around the school performing the lab. The lab presents a way to show all the forces acting on a moving object and allows students to measure and then calculate the forces. Methods will be presented to show how this lab can be successfully accomplished.

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SESSION II-2
9:20-9:35
Room 333

Title: Energy Pie Charts

Abstract:

Students have a built-in intuition about energy conservation that can be expressed through energy pie-charts. This discussion presents one representation of the energy approach, energy pie-charting, promoted by Gregg Swackhamer in his paper, *Making Work Work* and also in his recent paper, *Cognitive Resources for Understanding Energy*. This discussion is the opening act of the energy presentation by Hugh Ross, Noblesville High School.

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SESSION II-7
11:10-11:25
Room 333

Title: The Ubiquitous Quantum and Forgotten Gravity

Abstract:

Quantum gravity is the name for the problem of reconciling quantum mechanics with general relativity. Both quantum gravity and the unified field are inherent in the derivation of the Rydberg constant done by Neils Bohr. How gravity is fitted into Rydberg spectra requires a novel solution to the radial portion of the Schrödinger equation. The radii of any orbital of the periodic table are fitted by an aufbau matrix via a hill-climb PC program that also calculates their potentials. The 1-S atomic indicator, termed the principle numerical attribute, is periodic mirroring the radius.

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SESSION II
Room 333

Opening Session:

Andrew S. Hirsch
Head, Department of Physics
Purdue University

Rising to the Challenge

Lunch Speaker:

Mark P. Haugan
Purdue University
Associate Professor of Physics

Matter & Interactions: University Physics Reform and What It Can Mean for School Science."

SESSION II-8/9
11:30-12:05
Room 333

Title: Truly Integrating the Integrated Chemistry/Physics Curriculum

Abstract:

When the state first proposed the Integrated Chemistry/Physics course, teachers across the state scrambled to find resources to teach this course. Since the year of proposal was not a textbook adoption year, most schools continued teaching the course as one semester of chemistry and one semester of physics (much like physical science) instead of actually integrating both subject areas. Teachers at Elkhart Central High School have developed their own integrated curriculum to teach the Integrated Chemistry/Physics course based on one overarching topic: energy. The entire course was designed using lab equipment that was already available. Cathy Biller and Stacy McCormack will talk about the organization of the course and have items available for purchase. Learn how to do the same at your school.

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Stacy McCormack (smccormack@blueblazers.org)
Elkhart Central High School

SESSION II-10
12:10-12:25
Room 333

Title: What Should a High School Physics Course Look Like?

Abstract:

Within the next few years the Indiana Department of Education will be reviewing and likely revising science standards prior to the next science textbook adoption (2010). What is the purpose of the first high school physics course? What are the essential topics that should be included in the first course? What will prepare students for success in college science courses and in college physics in particular? What can high school physics teachers do to prepare students for success in life? What should the Indiana high school standards for physics look like to reflect the answers to these questions? If the members of the INAAPT (both secondary and post-secondary) can reach agreement on this and if we work with the Indiana Department of Education, we should be able to have a significant influence on the science standards review and rewrite.

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SESSION I-10
12:10-12:25
Room 338

Title: Testing for Yearly Improvement Using Successive Scores on Indiana's ISTEP Exams

Abstract:
The federal No Child Left Behind Act is having major impact on the schools of the fifty states. This Act requires that by 2014, every student must be proficient in reading, mathematics, and science, based on state benchmarks. As data from high stakes tests evolve at the thousands of schools in the 50 states, it is disturbing to the school principals, the teachers, the students, and their parents to see that it is very difficult to improve for 3 or 4 or 5 consecutive years. The true benefits of reform may not be seen immediately. The authors maintain that in most cases, what is being observed is random statistical fluctuation in school pass rates. Results will be presented from a bivariate analysis of Indiana's high stakes test (ISTEP) pass rates for grades 3, 6, 8, and 10 over a recent three-year period.

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SESSION III:1/2/3
9:00 – 9:55
Room 331

Title: Photosynthesis**:** is it physics?

Abstract:

Photosynthesis is the main source of energy used by all life on Earth. Our civilization's energy needs are covered almost entirely by the products of photosynthesis – such as oil, gas, coal. Photosynthesis has been traditionally considered to be a process to be studied almost exclusively by botanists and biologists. However, the discoveries of the last century have given us such deep insights on biological systems, that further understanding of life is impossible without applying most modern methods of physics as well as other sciences. In this talk, the connection between physics and biology will be demonstrated in the process of discussing the molecular mechanisms that make photosynthesis possible.

SESSION I-8
11:30-11:45
Room 338

Title: Experimental Error is a Number: Getting Students to Think Quantitatively

Abstract: Often, students' previous lab experiences lead them to think that lab work consists of following instructions, acquiring data, and fabricating reasons to explain why their results are wrong. Significant gains in the quality and sophistication of students' quantitative reasoning and investigative skills can be made by designing labs that give the students freedom to make their own decisions and opportunities to explore situations where the answers must be determined by experiment. A simplified method of calculating experimental error can be used to reinforce the idea that science is not about perfection or matching accepted values. A particularly effective component of laboratory instruction involves explicitly urging students to discuss and draw conclusions from their numerical data in a one-page narrative lab summary. By the end of one semester, the students are well on their way toward thinking like scientists.

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SESSION III: 4/5
10:00-10:35
Room 331

Title: National Center for Learning and Teaching in Nanoscale Science and Engineering

Abstract:

NCLT is a partnership between Northwestern University, Purdue University, the University of Michigan, Argonne National Laboratories, and the Universities of Illinois at Chicago and Urbana-Champaign. The NCLT mission is to develop scientist-educators who can introduce nanoscience concepts into the classroom, ensuring that all Americans are academically prepared to participate in the new opportunities nanotechnology will offer. Drawing on the strengths of its partners in nanotechnology, instructional materials development, educational assessment, and student cognition, NCLT is creating modular educational materials designed to integrate with existing curricula in grades 7-12 that will align with national and state science education standards. My talk will describe the history of nanoscience, its relation to traditional science and engineering topics, and the grand challenges facing nanoscience in the future.

SESSION I-6
10:50-11:05
Room 338

Title: Strings, Branes, Extra Dimensions, and Things"

Abstract:

Relative to these novel ideas, I plan to discuss some physics leading up to them, their meaning and legitimacy, and the value of incorporating some of them, and at what level, in the physics curriculum.

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SESSION III-6
10:50-11:05
Room 331

Dialogue between "the university" and "the high school"

This session is intended to provide a forum for those interested in educating high school physics students to exchange ideas, needs, and concerns.

Facilitated by: Julie Conlon
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SESSION I-4
10:00-10:15
Room 338

Title: Undergraduate Pulse NMR Experiments

Abstract:

Experiments to study proton resonance using TeachSpin's pulse NMR apparatus are described. A variety of pulse sequences are used. Measurements of magnetic moment, spin-lattice relaxation time, T_1, and spin-spin relaxation time, T_2, are reported. These experiments are designed for advanced undergraduate laboratory courses and for undergraduate projects.

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SESSION III-9/10
11:50-12:25
Room 331

Title: Astrophysical Jets Associated with Supermassive Black Holes

Abstract:

Astronomers have recently discovered that at the center of nearly every large galaxy in our universe there is an extremely massive black hole weighing over a million to several billion times the mass of our Sun. In a small fraction of these, conditions are such that most of the matter just outside of the black hole does not fall in, but is instead ejected at extremely high speeds in the form of jets. These jets can travel millions of light years before eventually disrupting into spectacular plumes of radio-wave emitting plasma. I will describe how we are studying these jets to learn about high energy physics, and will present recent images and movies I have taken using the world's most powerful radio telescopes.

Bio:

Dr. Matthew Lister is currently an assistant professor in the Physics Department at Purdue University. He received an undergraduate degree in physics from the University of Toronto in 1991, a master's degree in physics from the University of Victoria in 1993, and completed his doctoral thesis in astronomy at Boston University in 1998. Prior to

SESSION I-2
9:20-9:35
Room 338

Title: Looking for Fault Lines Using P-wave Anomalies

Abstract:

This project was to locate a potential fault line in Western Indiana using abnormalities in the arrival of P-waves. We chose earthquakes from the PEPP network to compare arrival times to predicted times. The resulting data was compiled in various Excel spreadsheets and plotted using DPlot. Our initial results indicate there is not a fault line in western Indiana.

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SESSION IV
9:00-12:00
On the Hour Tours—PRIME Lab
Meet in Room 223

Tour of the Purdue Rare Isotope Measurement Laboratory (PRIME Lab)

The Purdue Rare Isotope Measurement Laboratory (PRIME Lab) is a dedicated research and service facility for accelerator mass spectrometry (AMS). AMS is an ultra-sensitive analytical technique for measuring low levels of long-lived radionuclides and rare trace elements. At Purdue we have constructed a major national AMS facility centered around the Physics Department's tandem electrostatic accelerator. We are using the accelerator to measure both man-made and cosmic-ray-produced radionuclides such as ^{10}Be (half-life 1,600,000 years), ^{14}C (5730 years), and ^{36}Cl (300,000 years) in natural samples having isotopic abundances down to $1x10^{-15}$.

Bio:

Dr. David Elmore is currently a professor in the Physics Department at Purdue University. He received a B.S. in Physics in 1968 from Case Institute of Technology (Cleveland, OH), and a Ph.D. in Physics in 1974 from University of

SESSION I
Room 338

ANNOUNCEMENTS

1. Break Room: 242
   coffee, juice, donuts

2. Don't miss the posters in Room 242.

3. Lunch: Room depends on number attending; room will be posted.

Thank you to Purdue alumni who helped make this Spring meeting possible

Purdue Physics Alumni
Dr. David Mortara (BS, '61)
Dr. John Parker (PhD, '88) and (MS, '85)

Rochester (Rochester, NY). Prior to coming to Purdue, he was a research associate at the University of Rochester, a senior research associate at University of Rochester, and Physicist (CER/BEM) at Argonne National Laboratory. Professor Elmore's research interests include Accelerator mass spectrometry: development of methods for new isotopes, automation of isotope ratio measurements, ion source development, and new detector systems. Cosmogenic radionuclides in natural samples. Dating of rock exposure to cosmic rays using ^{36}Cl, ^{26}Al, and ^{10}Be. Biomedical applications. His teaching accomplishments include that he lectured introductory calculus-based mechanics and calculus-based electricity and magnetism and introduced the McDermott tutorials to the mechanics course (1800 students per year). He presently is lecturing algebra-based mechanics to technology students and modern physics to physics majors using peer instruction with clickers and just-in-time reading quizzes.

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SESSION II-1
9:00-9:15
Room 333

Title: Vector Components + Low Math Level = Pac-Man Rule

Abstract:

Many physics students understand that a vector pointed at 70 degrees has an "up-component" and an "out-component" and are quite capable of observing that the "up- component" is bigger. However, attempts to expand these observations into actual calculated values of components using trigonometry often block any further progress with physics students of limited math experience. The Pac-Man rule is a technique that allows students to calculate vector components without officially "invoking" proper trigonometry.

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SESSION II-6
10:50-11:05
Room 333

Title: Electric Field Mapping with "PC Oscilloscope"

Abstract:
The purpose of this talk is two fold. One is to introduce an inexpensive piece of equipment ($130.00) called "PC Oscilloscope" and its possibilities. The other is to use it to draw electric field equal potential lines. This lab is an easy one to do and many may already do it. I also have bigger plans for the "PC Oscilloscope" because it measures so much. It has a built in microphone and can measure light level, temperature, resistance and PH. It also has two external sensor receptacles. I am not sure how to use some of these capabilities but it could prove interesting. I'm open for suggestions. We have already used it to study light intensity and sound intensity relationship with distance. I feel this device can help any school try new experiments, and it gives all an inexpensive oscilloscope for their labs.

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