

"Inquiry in Physics Education"

Fall 2005 Meeting of the Illinois and Chicago Sections of the AAPT

October 28-29, 2005

Riverside - Brookfield High School, Riverside, Illinois

Friday, October 28, 2005

9:30 - 12:00 Registration - Science Hallway (Room 187)

10:00 - 12:00 Workshop 1a "Physics Modeling" - This workshop is only open to those who participated in the modeling cohort in the summer of 2005 at Dominican University. Room 185.

12:00 - 1:00 Lunch on your own

1:00 - 4:00 Registration - Science Hallway (Room 187)

1:00 - 1:15 Welcome - *Jack Baldermann*, Superintendent/Principal, Riverside-Brookfield High School, Room 183

** Indicates an Active Learning paper. Namely, papers A1-A4, A7-A8.*

1:15 - 3:30 Session A - Contributed Papers - Room 183

Session Chair: Zak Knott, Riverside-Brookfield High School

1:15 - 1:30 - A1

*** Visualizing the Universe: Using Spatial Relationships in Active Learning Exercises.** *Lee Carkner*, Augustana College, Rock Island, IL 61201. The mathematical content of most introductory science classes is focused on algebra. Here I present some attempts to use geometry, spatial relationships and visual aids to develop reasoning and critical thinking skills. While spatial reasoning is challenging for many students and is not as straightforward to teach as algebra, it offers many advantages, such as promoting more active in-class discussions between students and improved retention of the subject matter.

1:30 - 1:45 - A2

*** NSF PRISM Grant: University-High School Physics Inquiry Resources.** *Rebecca Wenning*, Illinois State University, Normal, IL 61790. Physics teacher education major, Rebecca Wenning, will present a summary of her experiences of working as a fellow on the NSF PRISM grant at Illinois State University. Through this grant she has worked with over 3,000 students and 13 science educators grades K-12 in central Illinois to develop and enhance inquiry activities. Rebecca will provide attendees with a number of examples of inquiry activities developed through the PRISM grant, as well as a list of on-line resources for more inquiry activities. She will also provide contact information for any teachers interested in taking advantage of the many benefits PRISM has to offer, including assistance from 17 graduate and undergraduate fellows in the areas of physics, chemistry, biology, and mathematics, university materials resources, matching grant funds, and teacher compensation.

1:45 - 2:00 - A3

*** TIPERs and MEAT.** *Curtis Hieggelke*, Joliet Junior College, *Steve Kanim*, New Mexico State University, and *David Maloney*, Indiana University-Purdue University Fort Wayne. TIPERs are based on the idea that good physics education research tasks often make excellent instructional exercises. TIPER formats include Ranking Tasks; Working Backwards Tasks; What, if anything, is Wrong Tasks; Conflicting Contentions Tasks; Changing Representations Tasks; Qualitative Reasoning Tasks; and others. This talk will feature the TIPERs that have been developed and published for important issues in electrostatics (and magnetism). The tasks are arranged into sets of issues that provide a way of asking similar or the same question in various ways. Such materials support active learning approaches, foster transfer of learning in the context of slightly different situations, and can be easily incorporated into current teaching formats without making major changes. It will also provide some results from a new assessment tool is called the MEAT for mechanics electrostatics assessment tool. Work supported in part by grants (DUE #9952735 & #0125831) from the National Science Foundation.

2:00 - 2:15 - A4

*** TYC & HS Physics Workshops for the 21st Century.** *Curtis Hieggelke*, Joliet Junior College, and *Thomas O'Kuma*, Lee College. This presentation will report on recent workshops offered for two-year college and high school physics teachers by this project which is ending soon. This includes workshops on LabVIEW and LabPro; Physlets and HTML; TIPERs; Modeling; Microcomputer Based Laboratories; Project-Based Physics; Investigative Science Learning Environment; and Introductory College Physics for the 21st Century. It will also feature the major projects completed by some of the participants. These workshops are designed to acquaint the participants with the integration and

implementation of emerging technology and active learning strategies. These workshops provide extensive and intensive, collaborative experiences for participants with workshop materials that make it easy for participants to implement the workshop ideas in their classroom. Supported in part by ATE grant #0101589 from the National Science Foundation.

2:15 - 2:30 - A5

Using Medical Scans to Examine Radioactive Decay. *Deborah Damcott, Collette Marsh*, Harper College, Palatine, IL 60067. Technetium-99m is a common isotope used in medical scans examining various parts of the human body. It is easy and inexpensive to produce, can be used to label a broad variety of substances, and has a half-life of approximately 6 hours. Two persons undergoing either heart or lung scans were injected with Tc-99m labeled carriers and studied for a period of approximately 3 days following the tests. Counting was carried out both at the injection site and near the organ of interest. Students in introductory physics were provided the data and created plots to determine the decay constant for the isotope. Results indicated a half-life lower than the accepted value.

2:30 - 2:45 - A6

I Always Wanted to Teach ASTROLOGY 101?? *Janet Landato*, Harper College, Palatine, IL 60067. Students in Introductory Astronomy completed a homework assignment which (a) taught them how to use planetarium software for their textbook and (b) encouraged them to consider astrology as a pseudoscience. Four groups of students "cast their horoscopes" by setting the software to the city, date, and time of their birth. Students recorded events in life for seven days and then looked up their horoscopes. Students decided if the horoscopes were valid. Many students completed the assignment with strong acceptance of the claims of astrology even if the evidence did not support the claims. Student preconceptions are just as persistent in astronomy as in physics.

2:45 - 3:00 - A7

* **Employing active learning to establish an empirical basis for kinetic energy.** *Carl J. Wenning*, Illinois State University, Normal, IL 61790-4560. Physics teachers often introduce the study of kinetic energy by stating without explanation or justification that kinetic energy is equal to one half the product of the mass and squared velocity. If a basis for this formulation is given at all, it often leaves students confused. Any reasonably skeptical student of physics would want to inquire as to the physical reason why kinetic energy is so defined. The simplest answer is that work and kinetic energy are conserved in certain situations if properly defined. Is there a laboratory activity that physics teachers might use to help introductory physics students understand that kinetic energy is indeed proportional to mass and squared velocity? Fortunately, the answer is "yes." The presenter will explain a simple, accurate, and effective active learning strategy that can be used to do so.

3:00 - 3:15 - A8

* **Understanding Electric Flux through Raindrops.** *Troy Gobble*, Riverside-Brookfield High School, Riverside, IL 60546. Will you stay drier running or walking in the rain? This driving question is used to introduce the concept of flux to the students. The raindrops provide an excellent mental model for electric field lines, and can help eliminate common misconceptions about electric flux.

3:15 - 3:30 - Take Fives

1. *Zak Knott*, Can you visit 7 continents in one day?
2. *Cliff Parker*, "Think Tube"
3. *Brennan Denny*, TBA

3:30 - 4:00 - Break with snacks provided - Room 186

4:00 - 5:00

"Panel Discussion on Physics Modeling"

Panel Members: Carl Wenning (moderator), Jim Stankevitz, Joselita Velasco, Johan Tabora, Yvonne Richter, Rodger Baldwin, Mona Hicks, Barbara Gottemoller, and John Sunta
Room 183

Physics Modeling Workshops designed for high school physics teachers were held at locations in several states this past summer. Participants in the two workshops that were held in Illinois will discuss their experiences. One of these was at Dominican University, River Forest, IL (July 11-29) and the other was at Wheaton-Warrenville South High School, Wheaton, IL (two weeks in August).

5:00 - 6:00 **Travel Time and Social Hour** - Casa Margarita, 32 S. LaGrange Rd., LaGrange, Illinois
6:00 - 7:20 **Banquet** - Casa Margarita, 32 S. LaGrange Rd., LaGrange, Illinois
Presentation of the *2005 Distinguished Service Citation* to Diana Roth.

7:30 - 8:30

"Project ARISE: A Revolution in Science Education"

Dr. Leon Lederman

Pritzker Professor of Physics, Illinois Institute of Technology

There is ample evidence that we are still a nation at risk. Our schools are clearly not producing students who can keep the nation at the frontier of science and mathematics. Immigration is dropping rapidly. We need radical reform of our science education and I will describe "a plan".

Saturday, October 29, 2005

7:00 - 8:00 **ISAAPT Council meeting** - Presiding: Kimberly Shaw, President, ISAAPT. Room 185

8:00 - 9:00 **Registration** - Science Hallway (Room 187)

8:00 - 8:45

"Teacher Candidate Recruitment, Preparation, and Retention"

A roundtable discussion sponsored by the ISAAPT Ad Hoc Committee on Teacher Recruitment, Preparation, and Retention.

Discussion Leader: Carl Wenning, Illinois State University
Room 183

ISAAPT members teaching at all levels are encouraged to contribute to a discussion about the problems facing the State of Illinois in finding, preparing, and supporting an adequate number of physics teachers in high school classrooms. Members are asked to assist with the preparation of a teacher recruitment brochure designed for high school physics students, as well as a recruitment guide for physics teachers at all levels.

8:45 - 9:00 **Break with continental breakfast provided** - Room 186

* Indicates an Active Learning paper. Namely, papers B2, B4-B5.

9:00 - 10:30 **Session B - Contributed Papers - Room 183**

Session Chair: Troy Gobble, Riverside-Brookfield High School

9:00- 9:15 - B1

Using Mathcad to Teach Solid State Physics. Dean Sieglaff, Augustana College, Rock Island, IL 61201. Mathcad is a technical calculation application that uses familiar math expression rather than "FORTRAN"-like character strings for the purpose of displaying and computing. With it, many of the principles of solid state physics, which are expressed as vector equations, can be "brought to life". The use of Mathcad in the generation and visualization of space lattices, crystal structures, primitive cells, and conventional cells, and in the calculation of cohesive energies, will be presented.

9:15- 9:30 - B2

* **Technology Outside of the Physics Classroom.** Zak Knott, Riverside-Brookfield High School, Riverside, IL 60546. The number and quality of tools available for communicating with students outside of the traditional classroom has grown tremendously in recent years. Additionally, students can be provided with opportunities to collaborate on homework and group projects over the internet. In this session I will share my experiences with my website PhysicsMonkey.com and show you how to get started using bulletin boards, wikis, and more in your own classroom.

9:30- 9:45 - B3

Determination of the Eccentricity of the Moon's Orbit. David Vassallo, Proviso West High School, Hillside, IL. The challenge in teaching astronomy as a high school course is to try to find ways to make the course more than mere memorization of facts. It is important to help the students come to some understanding of how science is done. The best place to do this is through lab exercises. I have developed a lab using images available on the internet that allows

students to not only see qualitatively, but to also quantitatively determine the variation in the size of the Moon's image. Plotting these changes yields an elliptical path from which the eccentricity can be obtained.

9:45 - 10:00 - B4

* **"Millikan Eggs"**. *Deborah L. Lojkutz*, Joliet West High School, Joliet, IL 60435. In teaching Physics, it is important to teach our students how to think and act like scientists. They need to be challenged to go beyond learning facts and formulas. Robert Millikan's oil drop experiments led to the measurement of the charge on the electron. The "Millikan Egg Lab" provides students with a model of how Millikan analyzed data to determine an unknown. This activity provides students with an opportunity to measure an unknown quantity indirectly by analyzing data. Instead of finding the charge on oil drops, the student determine the mass of "chickens" in plastic Easter eggs.

10:00 - 10:15 - B5

* **Students as Atoms: Understanding Various Phases of Matter: An Active Learning Exercise.** *Paul J. Dolan, Jr.*, Northeastern Illinois Univ., Chicago, IL 60625. "Active Learning" exercises can effectively be used to 'break the tedium' of a traditional lecture, and to involve students more directly in the learning process. In some of the most effective Active Learning, students not only participate orally, but participate 'physically'. Being 'microscopic, one of the more difficult situations to effectively present in class, especially to non-science majors, is the structure and motion of atoms, within the various phases of matter. An Active Learning exercise on the various states of matter will be demonstrated, which has been effectively used in the General Education Physics course at Northeastern. The students themselves serve as the individual atoms. Not only can the structure and motion of three simple phases, (Solid, Liquid, Gas) be shown, but this exercise facilitates discussion of other phases, such as ordered liquids (like water), magnetic materials, and phases where electron or particle pairing occurs, such as superconductivity and superfluidity.

10:15 - 10:30 - Take Fives

1. *Leonard T. Freidhof*, Graphing with Tin Cans and "Logs"
2. *Rob Mason*, "Latest News from the IAI Physics Panel"
3. *Kim Shaw*, "The Pink Fabric of Space-Time"

10:30 - 10:45 - Break with snacks provided - Room 186

10:45 - 12:00

"Problem Based Learning: A Bridge to Inquiry in Physics"

Deb Gerdes and Mike Lejcar

Illinois Mathematics and Science Academy
Room 183

Come experience the PBL problem-solving process from both the learner's and the teacher's perspectives. As a learner, you will "meet" a problem appropriate for physics classes and collaboratively think through the key elements of the problem. The "teacher talk" will include how to design PBL units to target your content and your learners. Walk away with valuable resources.

12:00 - 1:00 Lunch and Business Meeting. Lunch is provided by the Riverside-Brookfield Restaurant. Room 183

1:00 - 4:00 Workshop 1b "Physics Modeling" - This workshop is only open to those who participated in the modeling cohort in the summer of 2005 at Dominican University. Room 185.