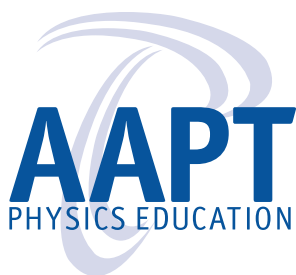




February 13-17, 2010

APS/AAPT Joint Meeting Preview



Physics for the Nation's Future

It has been nearly 15 years since the AAPT last held a national meeting in Washington, DC, and that was one of the last joint AAPT/APS Spring Meetings. (How many of you can remember that we used to hold THREE meetings each year!?) Now the “April” APS meeting and the “January” AAPT meeting have both been moved to February, and we are poised for what will likely be one of the best meetings our organization has had. Combining the availability of the scientific sessions of APS with our own usual high-quality workshops and sessions is bound to attract our members. Add to this, the excitement of being in the Nation’s Capital—with all of its historic, cultural, recreational and political activities, and personally, I can’t wait to experience the fruition of these many months of planning!

You will experience a number of changes for this winter’s meeting, for example, 36-minute invited talks and 12-minute contributed ones, two exciting plenary sessions featuring three talks each, and a joint exhibit area with a gala reception at 7:00 p.m. on Sunday. A very special Bridging Session on Saturday evening will begin a dialogue that focuses on ways in which the United States is addressing President Obama’s call to make STEM education a national priority. (I hope that the significance of this session and the high caliber of the speakers will hush the grumbling about Saturday workshops beginning at 7:30 a.m.!)

Our proximity to the Smithsonian Institution has inspired a workshop “Behind the Scenes at the Smithsonian,” and a session “Exploring the Nation’s Attic,” and hopefully you will also schedule some time to walk to the corner Woodley Park Metro station, and visit one or more museums. Our presence in the U.S. seat of power has inspired the sessions “Physicists Inside the Beltway,” “Selling Physics Research and Education to Congress,” and “Policy and Women,” and the meeting’s theme, “Physics for the Nation’s Future.” And, perhaps you will feel inspired to share your views with our lawmakers on Congressional Visit Day, Friday, February 12, organized by APS. If all of this hasn’t perked your interest, maybe the session “Secrecy and Physics,” and the showing of “Secrecy”—a film about the vast, invisible world of government secrecy—will!

The headquarters hotel, the venerable red brick Marriott Wardman Park, dates from the 1920s, and is located in a delightful area of D.C. with tree-lined streets, many international restaurants, and the National Zoo. (The oldest portion of the hotel is listed on the National Register of Historic Places, and has been home to three U.S. presidents!) I look forward to greeting you and our APS colleagues there in February.

Best regards,



David Sokoloff

AAPT Vice President and Winter Meeting Program Chair

Make your reservations now!

Program note: *This preview features a preliminary list of workshops, sessions, and events. Speakers and workshop descriptions are currently being confirmed. Visit www.aapt.org frequently to find up-to-date information.*

Why you should sponsor a meeting event:

- Great positioning for your organization
- Face-to-face contact with your target market
- The most effective way to showcase your product or service
- A captive audience that wants to learn and succeed

For more information on why this is a win-win opportunity, please contact **Philip Hammer** at 301-209-3310 or pwhammer@aapt.org

location & travel

The Nation's Capital

Many notable private universities are located in Washington, including the George Washington University (GW), Georgetown University (GU), American University (AU), the Catholic University of America (CUA), Howard University, Gallaudet University, and the Johns Hopkins University School of Advanced International Studies (SAIS). The Corcoran College of Art and Design provides specialized arts instruction, and other higher-education institutions offer continuing, distance and adult education. The University of the District of Columbia (UDC) is a public university providing undergraduate and graduate education.

Traveling to Washington, D.C.

By Air

Ronald Reagan Washington National Airport (DCA) is located in Arlington, VA, just across the Potomac River from the Nation's Capital. DCA is located approximately 9 miles from the Marriott Wardman Park.

Washington Dulles International Airport (IAD) is located in Chantilly, VA. IAD is located approximately 26 miles from downtown Washington, DC and the Marriott Wardman Park.

Baltimore-Washington International Thurgood Marshall Airport (BWI) is located in Anne Arundel County, Maryland and is about 10 miles south of Baltimore and approximately 30 miles northeast of Washington, DC and the Marriott Wardman Park.

Visit www.aapt.org/Events/wm2010/transportation.cfm for more information.

Rental Car Information

Avis is proud to offer special rates for the summer meeting. To reserve a car, contact Avis at 1-800-331-1600 and reference the Avis Worldwide Discount (AWD) number J945158.



The Lincoln Memorial is one of the many attractive sights to behold in the nation's capital.

By Train

Amtrak provides service to and from the BWI Marshall Rail Station, where free shuttles serve the airport terminal. To contact the BWI Marshall Rail Station, please call 410-672-6169. Take the Amtrak train from BWI Marshall Rail Station to Washington's Union Station. Board the Union Station Metro Red line train towards Shady Grove. Exit at the Woodley Park-Zoo Metro Station. www.amtrak.com

By Bus

Greyhound Lines, Inc., is the largest provider of intercity bus transportation, serving more than 2,300 destinations with 13,000 daily departures across North America. www.greyhound.com

METRO

The Washington Metropolitan Area Transit Authority (WMATA) operates the city's rapid transit system, Metrorail (most often referred to as the Metro), as well as Metrobus. The subway and bus systems serve both the District of Columbia and the immediate Maryland and Virginia suburbs. www.wmata.com.

meeting information

Registration Fees

	<i>Early Bird</i> (until 12/11)	<i>Advanced</i> (until 1/15)	<i>Onsite</i>
AAPT Member	\$320	\$390	\$465
AAPT Associate Member	\$420	\$510	\$560
Non-Member	\$470	\$560	\$610
Student*	\$95	\$115	\$145
Retired	\$160	\$190	\$210
1-Day Member	\$205	\$245	\$270
1-Day Associate Member	\$220	\$260	\$290
1-Day Non-Member	\$270	\$310	\$340

Retirees Breakfast: \$29
TYC Breakfast: \$29
Multicultural Luncheon: \$46

Cancellation Policy: To receive a refund, any changes and/or cancellations must be received in writing no later than Feb.1, 2010, and all cancellations will incur a \$50 FEE.

* Students are AAPT members who are graduate students. Student non-members must pay non-member rates, unless joining AAPT at the same time you are registering for the meeting. Undergraduate members attend for free.

2010 APS/AAPT Joint Job Fair

Recruiting new talent? Looking for a job or just want a glimpse of the market? Join us February 15-16 at the 2010 APS/AAPT Joint Job Fair. Check www.aapt.org/Events/wm2010/jobfair.cfm for more information.

2010 Physics Teacher Education Coalition Conference

Diversity in Physics Education: Preparing Teachers for the 21st Century

The 2010 PTEC Conference will be held February 12-13, 2010 in conjunction with the American Physical Society "April" Meeting and the American Association of Physics Teachers Winter Meeting. \$75 for PTEC members; \$250 for nonmembers. For information on PTEC membership and how to join, please go to www.PTEC.org/join

lodging info

The Washington Marriott Wardman Park is located at 2660 Woodley Road, NW, Washington, D.C. 20008. You may make a reservation by calling (800) 228-9290 or (202) 387-5397. In order to receive the group rate you must request the AAPT room block. You may also make a reservation via the Internet at cwp.marriott.com/wasdt/americanassocofphysics/

Room/Ride Share Program

If you are interested in sharing a hotel room or a ride to the conference, please go to www.aapt.org/Events/rsinfo.cfm for detailed information.

special events

High School Share-A-Thon

Sunday, February 14, 5-7 p.m.

Opening Reception

Sunday, February 14, 7-9 p.m.

And SPS Poster reception

"Secrecy," a film by Peter Galison and Rob Moss

Sunday, February 14, 9-10:30 p.m.

Monday, February 15, 4-5:30 p.m.

Tuesday, February 16, 7 to 8:30 p.m.

A film about the vast, invisible world of government secrecy.

First Timers' Gathering

Monday, February 15, 7:30-8:30 a.m.

Learn more about AAPT and the meeting at this breakfast event.

Two-Year College Breakfast

Monday, February 15, 7:30-8:30 a.m.

Join colleagues teaching in two-year colleges during this social breakfast event.

Spouses Gathering

Monday, February 15, 9-10 a.m.

Create connections with other spouses and partners of AAPT attendees. Start with a light breakfast and plan an afternoon sight seeing in the nation's capital.

Retirees Breakfast

Monday, February 15, 7:30-8:30 a.m.

Multi-Cultural Luncheon

Tuesday, February 16, 12:33-1:30 p.m.

Young Physicists' Meet and Greet

Monday, February 15, 12:33-1:30 p.m.

A place for 20 and 30 something physicists to mix and mingle.

Physics Exhibit Show, Daily Poster Session

Sunday, February 15, 7-9 p.m. (SPS poster reception)

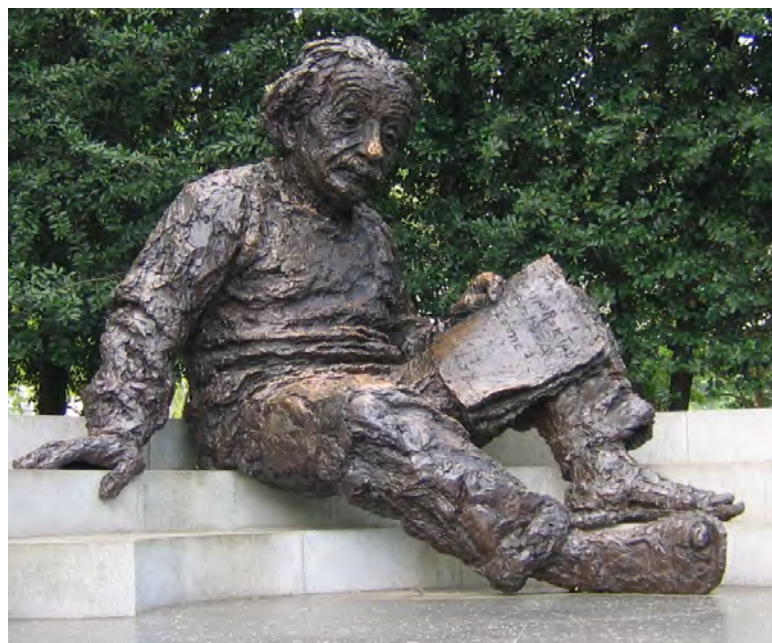
Monday, February 16, 10 a.m.-6 p.m.

Poster Session, 8:30-10:00 p.m.

Tuesday, February 17, 10 a.m.-4 p.m.

Poster Session, 9-10:30 p.m.

Exhibition Hall located on lower level of the Marriott.



Bronze statue of Einstein, on the grounds of the National Academy of Sciences on Constitution Avenue, near the Vietnam Veterans Memorial.

things to do in D.C.

Smithsonian: Start at the Smithsonian Institution Building on the mall where you can pick up a map and information on all of the museums. All buildings are free. There is a small charge for the IMAX movies at the Natural History Museum or the National Air and Space Museum.

Monuments and Memorials: Washington, D.C., is a city of monuments and memorials. We honor the generals, politicians, poets, and statesmen who helped shape the nation. Most famous monuments and memorials are on the National Mall: Washington Monument, Lincoln Memorial, Vietnam Memorial are near each other. WW II Memorial is relatively new on the mall.

Kennedy Center: Live theatrical productions at the John F. Kennedy Center for Performing Arts are entertainment at its finest. Purchase tickets in advance for performances ranging from musicals to concerts by the National Symphony or see a free show at the Millennium Stage. 2700 F. St. NW, Washington, DC near the Foggy Bottom/George Washington Univ. Metro Station. See www.kennedy-center.org

National Zoo: 3001 Connecticut Avenue NW Located very near Marriott Wardman Park Hotel, the zoo is open daily 10 a.m. to 6 p.m. and is free.

Ford's Theater: 511 Tenth St., NW The museum at Ford's Theatre was renovated in August 2009. The theatre is restored to look just like it did in 1865 when Lincoln was shot there. Also open is the Peterson House, across the street, where he died. www.fordstheatre.org/home

Melba Newell Phillips Medal

Mary Beth Todd Monroe, Southwest Texas Junior College, Uvalde, Texas
The Faces of AAPT

Monday, February 15, 1:30–3:18 p.m.

Mary Beth Monroe, long time AAPT member, has quietly and tenaciously served the organization at the state and national level for more than three decades. She served as AAPT Secretary and Chair of the Publications Committee from 2001-2007 and is currently serving as a member of the Committee on the Interests of Senior Physicists and as Chair of the Governance Review Committee. She has played a leading role in developing networks among physicists teaching in two-year colleges that have led both to their increasing involvement in AAPT and better teaching for the quarter of all introductory physics students who are students in the Two Year Colleges.

Monroe received her BS degree in physics from Sam Houston State University, Huntsville, TX, and her MS in Physics (research field, plasma physics) with double minor in Junior College Teaching (HEW intern) and Math, 1973. She is a dedicated proponent of quality physics education in two-year and community colleges. She served on the AAPT Executive Board as Member-at-Large Representing Two-Year colleges, and as a member of the Committee on Physics in the Two Year College. Additionally, she served as Principal Investigator and Project Director for TYC21 and as Co Principal Investigator for Strategic Programs for Innovations in Undergraduate Physics at Two Year Colleges from 2002-2005.



J.D. Jackson Excellence in Graduate Education Award

Eugene D. Commins, University of California, Berkeley, California
Some Personal Reflections on Physics Graduate Education

Monday, February 15, 1:30–3:18 p.m.

Eugene Commins, physics professor emeritus at the University of California, Berkeley, is the first recipient of the J.D. Jackson award. This award is given in recognition of contributions to graduate physics education, and awardees are chosen for their extraordinary accomplishments in communicating the excitement of physics to their students. Commins earned his BA with Honors in Mathematics and Physics at Swarthmore College and his PhD in Physics at Columbia University, New York City. He began his teaching career at Columbia University before moving to the University of California, Berkeley in 1960. Many distinguished scientists were taught and mentored by him, got their PhD's working with him, and speak passionately about him to their colleagues. Many of his students have gone on to sterling careers in their own right: our current Energy Secretary, Nobel Laureate Steve Chu, is an outstanding example of a student who was taught and mentored by Commins.



AAPT Distinguished Service Citations

Monday, February 15, 1:30–3:18 p.m.

Karen Williams is Professor of Physics at East Central University in Ada, OK. She earned her MS in Physics from the University of Arkansas, Fayetteville and her Ph.D. in Physics Education from the University of Oklahoma. Through her work with the Society of Physics Students, Dr. Williams has influenced thousands of future physics teachers.

An AAPT member for 20 years, she has been extremely active in the Arkansas-Oklahoma-Kansas Section, having held every office, including President, and hosting a section meeting at East Central University. Williams has presented several workshops at Section meetings, attended countless workshops herself, and been involved as Co-PI or lead teacher in two NSF grants training teachers in teaching physical science. She has generously donated her time and shared her expertise as a presenter at numerous AAPT national meetings.



Karen Williams

Patrick Whippey, the University of Western Ontario physics professor emeritus, is a very knowledgeable and dedicated physics teacher who is a role model to both educators and students. A willing and effective mentor to new and experienced teachers, he is well-respected among all of the OAPT Section members and hundreds of physics teachers and students across the province.

Whippey's service to AAPT, the physics profession, and the physics students and teachers of the Ontario Association of Physics Teachers has spanned over 40 years. He has made significant contributions to the Ontario section as a member of the Executive Board, OAPT section representative, and web master. He has made contributions to numerous activities for physics teachers such as a physics contest; physics photo contest; science shows and presentations for elementary, middle school, and high school students; science olympics; and science fairs. He is an OAPT member at large, organizer of the section and national conferences (one of them was the Canadian Association of Physicists – AAPT joint conference), and contributor to the Science Teachers Association of Ontario events.



Patrick Whippey

Beverly T. Cannon earned her BS in Chemistry at Mississippi State College for Women, her MS is in Science Education from the University of Southern Mississippi, and her PhD from Louisiana State University. She has actively sought to spread her enthusiasm for physics as a high school teacher and as a Physics Teaching Resource Agent in Texas where she regularly gives workshops to help high school teachers.

For nearly three decades she has devoted her time to serving in AAPT. Perhaps her most unique and respected contribution is her heroic efforts for the AAPT's video contest. Every year, there are new technological issues as students get more and more sophisticated and Trina has dealt with these changes in a timely and professional manner. AAPT is an organization of volunteers, and Trina is one of our organization's best.



Beverly T. Cannon

plenary sessions

Plenary Session I

The Kavli Foundation Joint Plenary Session

Saturday, February 13, 4–6 p.m.

Re-Energizing America's Focus on STEM Education

Shirley Malcom (American Association for the Advancement of Science)

Robert P. Moses (The Algebra Project)

This bridging session will focus on ways in which the United States is addressing President Obama's call to make STEM education a national priority.

Co-sponsored by APS and AAPT.

Plenary Session II

Monday, February 15, 8:30–10:18 a.m.

Co-sponsored by APS and AAPT.

A Space Program Worthy of a Great Nation

Norman R. Augustine (retired Chairman and CEO, Lockheed Martin Corporation)

Nucleon Spin Puzzle

Naomi Makins (University of Illinois, Urbana-Champaign)

Surface Temperature Responses to Natural and Anthropogenic Influences: Past, Present and Future

Judith Lean (Naval Research Laboratory)

Co-sponsored by APS and AAPT

Public Lecture

Monday, February 15, 7:00–8:30 p.m.

From Edible Lasers and the Search for Earth-like Planets—

Five Decades of Laser Spectroscopy

Theodor W. Hänsch (Recipient of the 2005 Nobel Prize in Physics with John L. Hall; Director, Max-Planck-Institute für Quantenoptik; Professor of Experimental Physics and Laser Spectroscopy, Ludwig-Maximilians Universität München, Germany)

Plenary Session III

Tuesday, February 16, 8:30–10:18 a.m.

Co-sponsored by APS and AAPT

Cosmology with the Cosmic Microwave Background

John Carlstrom (Kavli Institute, University of Chicago)

Early Results from the Kepler Mission

William Borucki (NASA Ames Research Center)

The Search for the Higgs Bosons and More at the Tevatron Collider

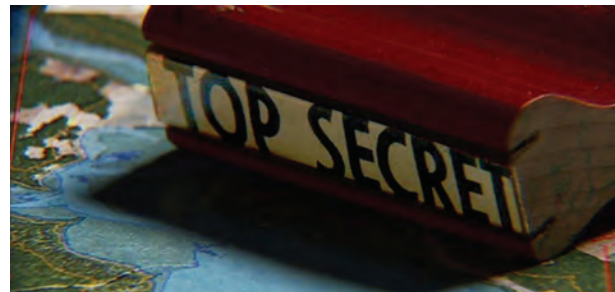
Rob Roser (Fermilab)

AAPT's Symposium on Physics Education

Tuesday, February 16, 1:30–3:18 p.m.

Educating Physics Teachers: A Call to Action for Physics Departments

The symposium will be dedicated to the memory of Len Jossem. Speakers include: Sheila Tobias, Mary Ann Rankin, and Stamatis Vokos.



SECRECY

A film by Peter Galison and Robb Moss

In a single recent year the U.S. classified about five times the number of pages added to the Library of Congress. We live in a world where the production of secret knowledge dwarfs the production of open knowledge. Depending on whom you ask, government secrecy is either the key to victory in our struggle against terrorism, or our Achilles heel. But is so much secrecy a bad thing? All showings in **Park Tower 8209**.

Showtimes:

Sunday, Feb. 14, 9:00 to 10:30 p.m.

Monday, Feb. 15, 4:00 to 5:30 p.m.

Tuesday, Feb. 16, 7:00 to 8:30 p.m.

Saturday, February 13

T01 Building Your Physics Course with ComPADRE

1–3 p.m. Saturday (\$35/60)

The ComPADRE online collections of physics educational resources contain many different types of materials to enhance physics courses at all levels. They also include the tools to help members build their own personal course collections. These include personal, sharable, online filing cabinets, editorial recommendations and features, and advanced search of the library. This tutorial will explore these tools with the goal of having participants begin building their own personal collections for a course they teach. Participants wishing to engage in the online tutorial activities should bring a computer with wireless internet capabilities. Those without computers will receive an overview of the ComPADRE collections, resources, and tools. ComPADRE, a collaboration of the AAPT, APS, and AIP, is supported by the NSF and is part of the National Science Digital Library. – **Bruce Mason**

W01 Physics Teaching and the Development of Reasoning

7:30 a.m.–3:30 p.m. Saturday (\$90/110)

Students come to high school and college physics with differing abilities to make sense of the phenomena of physics. Piaget and colleagues give a powerful description for this observation in terms of stages of the development of reasoning or cognitive abilities. This workshop, updated from the original AAPT 1975 workshop, will assist participants in identifying these stages of reasoning in the behavior of students in typical physics course activities. Participants will also experience and study the instructional design strategy called the learning cycle, developed by Robert Karplus, an original author of the 1975 workshop. This workshop in the late 70's was an important initial influence that ultimately resulted in the physics education research community. It is still valuable today to teachers and researchers. Participants will receive a copy of a new book, "College Teaching and the Development of Reasoning". Lunch is included in the price of this workshop. – **Dewey Dykstra, Robert Fuller, Tom Campbell, and Scott Stevens**

W02 Developing Physics Teacher Knowledge

7:30 a.m.–3:30 p.m. Saturday (\$80/105)*

Lee Shulman identified pedagogical content knowledge (PCK) as a necessary component of teacher knowledge - a blend of content and pedagogy that distinguishes the understanding of a pedagogue from that of a content expert. PCK is a very personal construct that is based on one's orientation towards teaching which in turn shapes the knowledge and attitudes towards students' ideas, different ways to represent those ideas, assessment strategies, and effective instructional methods within a particular discipline. The combination of the objective and subjective aspects of pedagogical content knowledge makes it difficult to teach and even more difficult to evaluate. What constitutes physics PCK and how can physics teachers construct and evaluate theirs? In this interactive workshop participants will reflect on their own PCK and develop some strategies for its improvement. They will also learn about a teacher preparation program that specifically focuses on helping future teachers build their physics PCK. Lunch is included in the price of the workshop. – **Eugenia Etkina**

W04 Physics by Design

7:30 a.m.–3:30 p.m. Saturday (\$95/120)

Participants will connect their teaching current practice to a model utilizing "Understanding by Design" as a planning tool to facilitate understanding and engagement in physics/physical science classrooms. This strategy also aids in teaching classes with diverse learners. Lunch is included in the price of the workshop. – **Julia Olson**

W05 Household Electricity in the Physics Classroom

7:30 a.m.–3:30 p.m. Saturday (\$115/140)

Everything you need to start a household electricity unit in your physics classroom. Participants will build a student station that will accommodate actual electrical components used in common household electric projects. The station includes a fused power supply, conduit-connected electric boxes which will simulate an actual house with actual electrical requirements. These include 2-way and 3-way switched overhead lamps, a common outlet, a complete bedroom, doorbells, thermostats and more! You'll actually bring home a brief-case-sized self-contained student station with all of the equipment to build the circuits above and plans to build similar kits for each of your lab stations. No experience necessary. We will build and assemble the stations during the morning and use them to perform the student experiments during the afternoon. The "final exam" will be building your own working lamp "from scratch". Come enjoy this totally hands on approach to the world of household electricity. Lunch is included in the price of the workshop. – **John P. Lewis**

W06 Behind the Scenes at the Smithsonian

7:30 a.m.–3:30 p.m. Saturday (\$45/70)

A behind the scenes tour of the Smithsonian Museum. See how exhibits are conceived, planned, researched, developed, and executed. – **John Roeder, William McNairy**

W07 Data Analysis Software, Astronomical Images and Physics Concepts

7:30 a.m.–11:15 a.m. Saturday (\$35/60)

Data Analysis Software, Astronomical Images and Physics Concepts This workshop will use Chandra x-ray archived data of supernovae remnants, variable stars, pulsars and white dwarfs and the Chandra ds9 image analysis software to investigate the physics of astronomical phenomena. Using ds9 analysis tools such as energy cuts, power spectra and light curves along with basic physics equations the following topics will be investigated: the distribution of elements in supernova remnants and the properties of the progenitor stars, determining if the core collapse resulted in a pulsar, magnetar or a black hole, calculation of the periodicity of two objects using centripetal acceleration and gravitational forces to determine if an object is a white dwarf or pulsar, using images and physics calculations to calculate the size, rate of expansion, and dates for supernova events. The ds9 software, tutorials, and download instructions, along with all activities are available on the Chandra education website (HTML and PDF) including pencil and paper versions. – **Douglas Lombardi, Donna Young, Pamela Perry,**

W08 Activity-Based Units for All Ages

11:45 a.m.–3:30 p.m. Saturday (\$75/100)

Looking for more activities with a solid educational content for your classroom or an outreach program? In this workshop, participants will work through sequences of hands-on connected activities covering each of the following topics: heat, sound, and electro-magnetism. Presenters have used these activities in a variety of settings including outreach programs with elementary and middle school students, high school physics classes, college physics courses for non-scientists and teacher in-services. Presenters strive to use inexpensive materials. Participants will receive sample materials for many activities and a resource CD.

– Richard Flarend, Alice Flarend

W09 Ben Franklin as My Lab Partner

11:45 a.m.–3:30 p.m. Saturday (\$50/75)

Benjamin Franklin's experiments and observations on electricity established his reputation as a scientist, our electrical conventions and vocabulary, and the principle of charge conservation. In his letters, Franklin builds, test, and defends his model with skill and eloquence, arguing from experiment, sharing both his wisdom and doubts, while conveying his fascination with electricity. As Franklin lacked formal schooling in mathematics, his theory was qualitative, and is an approachable example of hands-on and minds-on construction of a conceptual model with significant explanatory power. In this workshop (developed at the Wright Center for Science Teaching at Tufts University), working with Franklin's descriptions, we will recreate many of his experiments using modern, inexpensive materials. Participants will receive a kit of materials, selections from the workshop manual and a CD-ROM containing the complete workshop manual, a collection of Franklin's letters relating to electricity, and movie clips illustrating the experiments. –Robert A. Morse

W10 Condensed Lecture Demonstration Workshop

11:45 a.m.–3:30 p.m. Saturday (\$70/95)

During this ½ day workshop, we will introduce you to the Physics Resource Instructional Association (PIRA) and the PIRA 200. The PIRA 200 are the 200 most important and necessary demonstrations needed to teach an introductory physics course. Each demonstration has a catalog number according to the Demonstration Classification System (DCS); we will introduce you to the system used to classify these and the bibliography that details journal articles and demonstration manuals for construction and use in the classroom. We will also show a subset of approximately 50 demonstrations explaining use, construction, acquisition of materials, and answer any questions in this highly interactive and dynamic environment. Ideas for organizing and building your demonstration collection will be presented. We especially invite faculty members teaching introductory physics to attend. – Dale Stille, Sam Sampere

W24 Live Photo Physics: Video-Based Analysis Activities for the Classroom/Homework

11:45 a.m.–3:30 p.m. Saturday (\$50/75)

Live Photo Physics: Video-Based Analysis Activities for the Classroom/Homework This workshop is for physics teachers who wish to explore the use of video-based motion analysis in a wide range of applications including tutorial and collaborative problem solving sessions, projects and homework. Participants will learn how to make digital video clips for analysis, as well as how to use video analysis for homework problems and

in the classroom. We will discuss educationally effective uses of video analysis being developed in the LivePhoto Physics project, the Workshop Physics project and in other settings. Evaluation copies of selected digital video clips and homework assignments will be provided to the participants for their use after the workshop. The software used in this workshop is available for both Mac and Windows computers. Participants in this workshop may find that some prior, hands-on experience with basic video analysis using software such as VideoPoint or Logger Pro will be helpful but is not required. (Format: Mac/PC) – Priscilla Laws, Robert Teese, Maxine Wills and Patrick Cooney

Sunday, February 14

T02 Civic Engagement and Service Learning: The SENCER Project

12:45–2:45 p.m. Sunday (\$35/60)

This tutorial is aimed at those interested in improving physics education within the context of civic engagement (including service learning). During the tutorial we will describe the national dissemination program SENCER—which connects science and civic engagement by teaching “through” complex, capacious, and unresolved public issues—and ways to participate in its activities. We will also discuss ways to include service learning in the physics curriculum using examples from across the country, and engage in group activities that will provide a springboard for making curricular changes that will make civic engagement an integral part of the physics curriculum. – Theo Koupelis

T03 Multimedia Modern Physics for High School Teachers

12:45–2:45 p.m. Sunday (\$40/65)

Dark matter, string theory, and high energy particle accelerators. Do you need to be a Ph.D. from MIT to understand these things? Physics of the 21st Century, funded by Annenberg Media, is an upcoming, free, online resource covering the frontiers of physics research. Developed by the Harvard-Smithsonian Center for Astrophysics and designed by Harvard professor of astronomy and physics, Christopher Stubbs along with leading content experts, the multimedia course will connect the new ideas of contemporary physics with familiar ideas from classical physics. This workshop will introduce the course materials (to be released in fall 2010) including video profiles of research teams working on superconducting materials and the course Web site. The goal of the materials is to help both teachers and the public better understand and appreciate the science behind the headlines of physics breakthroughs. – Michele McLeod, Alex Griswold

T04 Monster in the Middle

12:45–2:45 p.m. Sunday (\$40/65)

Students get excited about science when they hear “black holes.” In this session we will consider different types of galaxies, the black holes at their centers, and what would happen if you “fell” into a black hole. Participants will receive materials about black holes, take part in hands-on activities, and learn interesting information that can be used in science

workshops (cont.)

classrooms (particularly physics and astronomy classes) to draw students into great physics topics using space as the stage. Materials are provided by NASA. – **Mandy Frantti**

W03 Using Research-based Curricula and Tools to Revitalize Your Introductory Courses

8 a.m.–4:30 p.m. Sunday (\$80/105)

Using Research-based Curricula and Tools to Revitalize your Introductory Courses This hands-on workshop is designed for those who want to introduce active learning and computer tools into their introductory courses. We will introduce new approaches to teaching based on physics education research (PER) in lectures, labs, and recitations as well as studio and workshop environments. Among the approaches presented will be Interactive Lecture Demonstration (ILDs), Web-Based ILDs, RealTime Physics Labs, Activity Based Tutorials, Collaborative Problem-Solving Tutorials, Live Photo Assignments and Workshop Physics, as well as analytic modeling and video analysis tools. The computer tools used are available for both Macintosh and Windows computers. Results of studies on the effectiveness of these teaching strategies will also be presented. Current versions of the curricula, along with the book “Teaching Physics with the Physics Suite” by E.F. Redish will be distributed. Partially supported by the National Science Foundation. Lunch is included in the price of the workshop. – **David Sokoloff, Ronald Thornton, Priscilla Laws**

W11 Research-based Alternatives to Problem Solving

8 a.m.–4:30 p.m. Sunday (\$60/85)

Accumulating research on problem solving in physics clearly indicates that traditional, end-of-chapter exercises in physics texts are not useful and may actually hinder students’ learning of important physics concepts. The research also raises questions about the efficacy of such tasks for helping students develop “problem solving skills.” In light of these results the question is: What alternative tasks can we use to help students develop problem solving skills and a conceptual understanding? This workshop will review the research and then provide examples of several alternative tasks and their use. Participants will also get practice writing alternative problems for use in their own classrooms. – **Kathleen Harper, Thomas Foster, David P. Maloney**

W12 Teaching Physics for the First Time

8 a.m.–4:30 p.m. Sunday (\$90/115)

With the push for physics first, many middle school and high school instructors find themselves assigned to teach physical science and physics classes with little or no formal preparation in the content. “Teaching Physics for the First Time” is designed to provide a supply of lessons based on the learning cycle that are reliable and cost-effective. The labs, demonstrations, and activities emphasize the hands-on approach to learning physics concepts and include teaching strategies and address misconceptions students often have with respect to the concept. The workshop attendees will receive a copy of the book *Teaching Physics for the First Time*. – **Mary Winn, Jan Mader**

W13 Going Deep to Reach the Stars

8 a.m.–4:30 p.m. Sunday (\$80/105)

Presented by: Peggy Norris, Sanford Underground Laboratory at Homestake and Black Hills State University, and Cathy Ezrailson, University of South Dakota The Deep Underground Science and

Engineering Lab, an NSF project being planned for the former Homestake gold mine in Lead, South Dakota, will attempt to answer questions at the forefront of our knowledge of fundamental physics and the nature of the cosmos by putting large detectors a mile deep. In this workshop we will explore two of those questions: What is the nature of dark matter, and what is the nature of neutrinos? The workshop will consist of both classroom activities and material exploring these questions and how scientists hope to answer them. – **Cathy Ezrailson, Peggy Norris**

W14 Using the Wii for Fun and Physics

8–11:45 a.m. Sunday (\$50/75)

Over 30 million Wii remotes have been sold and many of our students have or do use them. You will learn how to use the Wiimote as a 3-axis accelerometer in the physics lab. Then, you will assemble an IR pen and use the Wiimote to create a fairly Smart Board for use in your classroom. Participants **MUST** bring their own Wiimote to the workshop. – **Dwain Desbien, David Weaver**

W15 Ranking Tasks in Astronomy

8–11:45 a.m. Sunday (\$35/60)

Ranking tasks are a powerful example of curricular materials for promoting active engagement. A ranking task provides the learner with a series of pictures or diagrams that describe several variations of a basic physical situation. The student is then asked to make a comparative judgment and rank the various situations based on some criteria. These novel and intellectually challenging tasks effectively probe student understanding at a deep conceptual level. This workshop focuses on two libraries of ranking tasks for use in introductory astronomy at either the college or high school level: 1) pencil-and-paper versions appropriate for group work in the classroom, and 2) computerized versions that contain extensive randomization and feedback. Participants will work through several ranking tasks and then discuss implementation in their own classrooms. Participants will be asked to download software and install it on a laptop which they will bring to the workshop. – **Kevin Lee, Edward Prather**

W16 Equity Education “Outside the Box”: Exploring Issues of Race and Gender in the Classroom Through the Lens of Privilege

8–11:45 a.m. Sunday (\$50/75)

Often discussions of race and gender center on the deficit model (why are “they” not succeeding, what are “they” lacking, etc.). This focus encourages solutions focused on changing “them” such as providing mentors or extra tutoring and experiences. Rarely do we examine aspects of our own privilege as educators, and how our privileges damage us and create unproductive environments in our classrooms. In this workshop we will challenge this traditional framing and consider issues of race and gender through the framing of privilege. Through activities and discussion we will explore the concept of privilege, how it plays out in the classroom, and how it can be used to rethink classroom practices. We will acknowledge and explore the emotional turbulence that the lens of privilege often creates, but focus on how we can redirect this emotional energy to empower ourselves and our students. – **April K. Hodari, Melissa Dancy**

W17 A New Model of Instruction for the Urban Physics Classroom**8–11:45 a.m. Sunday** (\$35/60)

Many PER-based materials are designed for institutions that serve largely traditional student populations in fairly rigid learning environments. The introductory physics course at the urban institution is often small, with students remaining in a single room for all components of the course (lecture, laboratory, problem-solving, etc.). Chicago State University and the City Colleges of Chicago are capitalizing on these features to create a learning environment where students continuously move back and forth between course components. To aid in the implementation of this environment, CSU is creating an Interactive Physics Workbook that provides a clear structure for the course. The workbook contains lecture notes, discussion questions, TIPERS, problem-solving tasks, and laboratories that are often broken up. The material in this workbook comes from a diverse group of collaborators. In this workshop, participants will be placed in this learning environment and will get a sense of how the various components cohere into one unit. – **Mel Sabella**

W18 Designing and Implementing an Inquiry-based Physics Course for K-12 Teachers***8–11:45 a.m. Sunday** (\$60/85)

Designing and Implementing an Inquiry-based Physics Course for K-12 Teachers* Laboratory-based, inquiry-oriented courses can help teachers develop the depth of understanding necessary to teach physics as a process of inquiry. For over 30 years, the Physics Education Group at the University of Washington has been offering such courses using Physics by Inquiry, a research-validated curriculum. (1) This workshop is intended for faculty and others responsible for the preparation and professional development of K-12 teachers. Participants will have hands-on experience with the curriculum. By examining pretest and post-test responses, participants will also gain insight into the impact of the curriculum on teacher understanding. Critical intellectual and practical issues associated with the development and implementation of such courses will be discussed. (1) Physics by Inquiry, L.C. McDermott and the Physics Education Group at the University of Washington, Wiley (1996).* Supported in part by the National Science Foundation, most recently under DRK-12 grant #0733276. – **Lilian McDermott**

W19 Using Easy Java Simulations for Physics Teaching**8–11:45 a.m. Sunday** (\$35/60)

This workshop shows how to use the open-source Easy Java Simulations (EJS) authoring and modeling tool for teaching. We will describe the simplified structure and extensive scaffolding provided by the tool to create interactive, dynamical, effective simulations and we will show how teachers can connect from EJS to national digital libraries to download hundreds of ready to use simulations. These simulations can be used for computer demonstrations or virtual laboratories in high-school and undergraduate courses, or serve as programming examples and tasks for Computational Physics and higher-level students. These EJS simulations are ready to be distributed on a CD or published on a Web page as Java applets. Additional information is available at: . Partial funding for this workshop was obtained through NSF grant DUE-0442581. – **Wolfgang Christian, Mario Belloni**

W20 Just-in-Time Teaching: Using the Web to Create an Active Learning Classroom**8–11:45 a.m. Sunday** (\$85/120)

Just-in-Time Teaching: Using the Web to Create an Active Learning Classroom This workshop will introduce the Just-in-Time Teaching (JiTT) method, which promotes active learning in the classroom, improves student engagement and morale, and helps students to stay caught up in the class. JiTT does this by establishing feedback between students' homework/study time and the time they spend in the classroom. The World Wide Web is used as a communications tool to establish this feedback. During the workshop, participants will learn what JiTT is, why it works, and how it can be implemented in a wide range of educational settings. Assessment data and techniques will also be discussed. There will be an emphasis on developing the resources to implement JiTT easily and effectively, and participants will leave the session with some material for their courses already complete. JiTT has been adopted by hundreds of faculty worldwide, in a wide range of classes in science, mathematics, and the humanities. – **Andy Gavrin**

W21 Designing a Diagnostic Learning Environment: A Workshop for Teacher Educators**12:45–4:30 p.m. Sunday** (\$35/60)

A diagnostic learning environment is one in which assessments are used for formative purposes. Formative assessment identifies the details of students' understanding and reasoning. This allows the teacher to address specific student ideas with targeted instruction. What does formative assessment look like and why do we think it is important? How do teacher-educators help pre-college teachers construct an understanding of what formative assessment is and how to implement it? In this workshop we will analyze video and written classroom data, diagnose student understanding of specific ideas using evidence from classrooms, and consider instructional implications. We will consider evidence of ways in which pre-college teachers understand and implement formative assessment in their classrooms. In addition, participants will learn about the Diagnoser Project's free instructional tools to help diagnose precollege student thinking and guide instructional decisions. – **Eleanor Close, Hunter Close, Lezlie DeWater**

W22 Following Students' Learning in the PET, PSET and LEPS Courses for Prospective Elementary Teachers***12:45–4:30 p.m. Sunday** (\$40/65)

Following Students' Learning in the PET, PSET and LEPS Courses for Prospective Elementary Teachers* Physics and Everyday Thinking (PET)** and Physical Science and Everyday Thinking (PSET)** are one-semester guided inquiry courses intended for prospective and practicing elementary teachers or students needing a general education science course (<http://www.petpset.net>). Both courses engage students in activities involving standards-based content, the nature of science, and learning about one's own learning and the learning of younger students. After providing a curricular overview, we will view video snippets of students engaged in various activities within the courses. The snippets

will provide opportunities to analyze students' ideas and reasoning and discuss the roles of social interaction, laboratory experiments, computer simulations and the written curricula in promoting student learning. Finally, we will present recent work on a version of the course intended to meet similar goals in a large-enrollment format, called Learning Physical Science (LEPS). *Supported by NSF Grants 0096856 and 0717791. **Published by It's About Time, Herff-Jones Education Division. – **Fred Goldberg, Steve Robinson, Valerie Otero**

W23 Tutorials in Introductory Physics*: A Research-Validated Approach to Improving Student Learning

12:45–4:30 p.m. Sunday (\$55/80)

Tutorials in Introductory Physics*: A Research-validated Approach to Improving Student Learning Tutorials in Introductory Physics (1) is a set of instructional materials intended to supplement the lecture, textbook, and laboratory of a standard calculus-based or algebra-based introductory course. The tutorials are designed to address specific conceptual and reasoning difficulties that have been identified through research. In addition to providing hands-on experience with the curriculum, the workshop will include discussions of instructional strategies and results from assessments of student learning. Important aspects related to implementation of the tutorials will be covered, including preparation of graduate teaching assistants, undergraduate peer instructors, and post-docs. Copies of Tutorials in Introductory Physics will be provided to participants. (1) Tutorials in Introductory Physics, First Ed., L.C. McDermott, P.S. Shaffer, and the Physics Education Group at the University of Washington, Prentice Hall (2002). * This work has been supported in part by a series of grants from the NSF, the most recent of which is CCLI grant #0618185. – **Lillian McDermott**

W25 Laboratories With Biomedical Applications

12:45–4:30 p.m. Sunday (\$55/80)

There is a growing recognition of the need for laboratory activities that allow life science and biophysics students to explore and deepen their understanding of physics through such contexts as physiology, medical diagnostic and therapeutic devices, biomechanics, biological processes, and biological research techniques. Several individuals and groups who have been working independently on such laboratory activities will present examples of their labs. After an initial overview by all the presenters, participants will break into rotating groups for hands-on experience with different laboratory activities and more detailed discussion with each presenter about the pertinent pedagogy and apparatus. A flash drive with materials for all the laboratory activities will be given to the participants. – **Nancy Beverly, Dean Zollman, Dyan McBride**

W26 TA Preparation: Challenges and Successes

12:45–4:30 p.m. Sunday (\$35/60)

Being a teaching assistant is often the first professional experience for physics students. Preparing students to be successful TAs gives them a positive attitude toward their graduate career. TA preparation and support influences how physics students interact within the department and colors their outlook towards teaching. Because TA duties usually comprise the largest single block of time for a physics student, whether graduate or undergraduate, adequate TA preparation assures that it is a productive part of their education. This workshop will explore how TA preparation programs help integrate the TA experience into the education of a

physicist while facilitating the teaching of undergraduates in a physics department. Several examples of successful physics TA preparation programs will be presented and discussed. Participants will be able to discuss their goals, challenges, and constraints for TA preparation at their institution and compare with other institutions represented at the workshop. – **Ken Heller**

W27 Nuclear Forensics

12:45–4:30 p.m. Sunday (\$35/60)

Nuclear science meets CSI in this unit on nuclear forensics, intended for high school physics, chemistry or forensics courses. A set of five lessons uses nuclear forensics scenarios to introduce nuclear science in a context that the students might find interesting. These lessons, which are flexible and designed to take up to ten hours of class time, include background on nuclear science and case studies in which students analyze data from interdicted nuclear material. The workshop includes hands-on activities and mathematical modeling designed to develop students' critical thinking skills. The laboratory component includes detection of radiation from common materials and other sources, shielding experiments and more. Participants will be given both the student packets and teacher packets for the lessons. – **Monica Plisch, Ed Lee, Duke Writer, Jennifer Flynn**

W28 N-TIPERS: Research-based Conceptual Reasoning Tasks for Introductory Mechanics

12:45–4:30 p.m. Sunday (\$35/60)

N-TIPERS: Research-based Conceptual Reasoning Tasks for Introductory Mechanics A common question instructors wrestle with is: How do I get my students to develop a strong understanding of physics? In this workshop, you will explore some new materials designed to get students to think about fundamental concepts in alternative and multiple ways to promote robust learning. Participants will work with a variety of tasks and task formats, including clickers, that require student to think about the basic physics in the domains of kinematics and dynamics, including rotational dynamics, in nonstandard ways. Participants will be given a CD with more than 400 tasks and other materials. – **David Maloney, Curtis Hiegelke, Steve Kanim**

Monday, February 15

Panel: International Issues in Physics Education

10:45 a.m.-12:33 p.m.

Speakers: Lei Bao, Yuying Guo, Dewey Dykstra, and Pratibha Jolly

Bridging the Gap in Physical Science: Teaming H.S. Teachers and K-8 Teachers

10:45 a.m.-12:21 p.m.

Bridging the Gap in Do You Have What It Takes?, Karen Jo Matsler
Specially Designed Training for Texas Teachers: A Different Model, Tom O'Kuma

Bridging the Gap in Taking PIE into Overdrive, Laura Akesson
Simplifying Physics for Elementary, Jeffrey Elmer

Interactive Lecture Demonstrations: Physics Suite Materials that Enhance Learning in Lecture

10:45 a.m.-12:33 p.m.

Interactive Lecture Demonstrations: Active Learning in Lecture, David Sokoloff

Interactive Lecture Demonstrations: Effectiveness in Teaching Concepts, Ronald Thornton

Astrophysics in the Classroom

10:45 a.m.-12:33 p.m.

Astrophysics in the Classroom—Using CPEP Materials, Samuel Lightner
NASA's Space-Weather Action-Center: Educational Technology to Engage Teachers and Students, Troy Cline

Remote Observing Telescopes for the Classroom and Student Projects, Mary Ann Kadooka

Decades of Dark Matter and Dark Energy in Intro Astronomy, Curt Foltz
Astrophysics in the Great Expectations, Great Results Classroom, Gillian Winters

SPS Undergraduate Research and Outreach

10:45 a.m.-12:33 p.m.

Data Acquisition System for Muon Detectors at CSU, Macario Cervantes
Muon Detector Simulation, Marianela Perales

Cathode Interface Studies of Polymer Light Emitting Devices, Stephen Swiontek

Titanium Films for Dye Sensitized Solar Cells, Christopher Grablutz
Study of Structural, Electronic and Magnetic Properties of Nanostructures formed by Microbeads, Laxmidhar Senapati
Spectroscopic Ellipsometry: Multilayer and Porous Structures, Steven Jackson

Stability of Long-Range Wave Propagation, Elizabeth Bernhardt
Zinc Oxide Nanostructure Grown by Chemical Vapor Transport, Bradley Golder

ZnO Thin Films and Nano-Whiskers via Thermal Oxidation of Zinc, Mario Jones

National Resources for Science Education

10:45 a.m.-12:33 p.m.

Resources from the Koshland Science Museum of the NAS, Erika Shugart
National Resources for High School Student Research at the Carnegie Institution of Washington, Stephen Gramsch

Support for Pre-Secondary STEM Education at the Smithsonian Institution's National Air and Space Museum, Steven Williams

Teaching with Technology I

10:45 a.m.-12:33 p.m.

Using WebAssign to Enhance the Undergraduate Laboratory Experience, John Risley

Extending Just-in-Time Teaching by Way of Worked Examples, Gregor Novak

Enhancing Learning Through Easy Java Simulations (Ejs), Andrew Duffy

Clicker Program Implementation at a Small Liberal Arts University, Heather Whitney

The Use of WIKIs in 9th Grade Physics, Pete Lohstreter

Using a Student Response System to Increase Student Engagement, Joshua Ravenscraft

Students' Perceptions about MBL Usage in Optics, Fatma Caner

Exploring Physical Phenomena with Dynamic Graphical Story Telling, Charlotte Trout

Interactive Physics Illustrations Using Geometer's Sketchpad, Dale Yoder-Short

Reforming Introductory Physics Courses for Life Science Majors II

10:45 a.m.-12:33 p.m.

Findings of the AAMC-HHMI Scientific Foundations for Future Physicians Committee, William Galey

Responses to the AAMC-HHMI Scientific Foundations for Future Physicians Report Reforming Introductory, Suzanne Amador Kane

The Other Half of Western Civilization: An Experiment in Multidisciplinary Education, William Bialek

PER: Topical Understanding and Attitudes

10:45 a.m.-12:21 p.m.

The Way Things Work – Projectbased Electricity and Magnetism for Engineers, Rebecca Christianson

Adapting Research-based Instructional Materials to Meet Institutional Constraints, Mila Kryjevskaja

Investigating Student Understanding of the Particulate Nature of Matter, Amy Robertson

Use of Multimedia Learning Modules in Teaching Electricity and Magnetism, Homeyra Sadaghiani

Why Problems Related to Continuous Charge Distribution Are so Difficult for Students, Irina Struganova

Concerning Longitudinal Wave Demonstration with Candle Flame and Loudspeaker, Zdeslav Hrepic

Looking at Teacher Content Misconceptions and a Successful Intervention Strategy, Mark Greenman

Student Attitudes Towards Using Physics in Biology, Kristi Hall

Information Fluency and Physics Curriculum

3:30 p.m.-5:54 p.m.

Engaging the Students, Involving the Faculty, and Convincing the Audience, Jean-Francois Van Huelé

Teaching Research Skills: Why Do It? Who Should Do It?, Adriana Popescu

Developing Lifelong Learning Skills Through a Great Issues Course, Michael Fosmire

Developing Lifelong Learning Skills Through a Great Issues Course, Andrew Hirsch

Unconventional Laboratories

3:30 p.m.-5:54 p.m.

Studying the Students: Critical Investigations into a Physics Laboratory Course, Jennifer Blue

Doing Gender in the Physics Student Laboratory, Anna Danielsson

Busting Mythconceptions about Physics Concepts in the Introductory Laboratory, Stephen Van Hook

Exploring Crystallization – Low Cost, Hands-on Experiments with Candy Glass, William Heffner

The Application of Play Theory to Laboratory Pedagogy, Juan Burciaga
Examples of Research-Level Laboratory Experiments for High School Students, Sophia Gershman

Teacher Training/Enhancement

3:30 p.m.-5:18 p.m.

Playing Inquiry-Based Science: Video Games for Science Teachers, Danielle Harlow

Things I Learned from Teaching Astronomy to Teachers, Todd Brown

Empowering Teachers with the Development of Representations of Physics Scenarios, Rachel Scherr

Michelle Advocating a New Perspective on TA Professional Development, Renee Goertzen

The Development of Scientific Reasoning Abilities in Pre-service, Kathleen Koenig

Developing Mathematical Reasoning within the Physics Curriculum, Suzanne White Brahmia

Preparing Instructors to Teach an Intensive STEM Course, Vincent Bonina

Preparing Preservice Elementary Teachers for Inquiry-based Physics, Annmarie Ward

Iowa Physics Teacher Instruction and Resources (IPTIR), Lawrence Escalada

TA Training: Why it is Important and How to Do it Effectively

Session Dedicated to Cornelius Bennhold

3:30 p.m.-5:54 p.m.

Educating the TA: A Key to a Physicist's Professional Development, Kenneth Heller

On the Front Lines: Graduate Student Insights on TA Training, Amber Stuver

Professional Development of Graduate TAs: The Role of PER, MacKenzie Stetzer

Helping TAs Learn To Teach in a Studio Setting, Mary Bridget Kustusch

Physics Outreach

3:30 p.m.-5:06 p.m.

The SPS Intern Experience: Preparing the 2009 SPS Outreach Catalyst Kit, Erica Watkins

After-School, Activity-based Physical Science in a Low-income, Rural County, Staci Small

QuarkNet and Chicago State University, Jamall Davis

Using the Context of Modern Experimental Physics in the Undergraduate Curriculum, Sharif Onihale

Education and Outreach for Neutrino and Dark Matter Physics, Katherine Guenther

Neutrinos and Dark Matter in the Black Hills, Margaret McMahan Norris

Online Astronomy Resources from the American Museum of Natural History, Robert Steiner

Optics and Light Activities for Teachers of all Grade Levels from Easily Obtainable Supplies, Richard Lindgren

HEP Data in Education and Outreach Efforts, Matt Bellis

The Things Accomplished Teachers Do in Their Classrooms—Who Prepares Them?

3:30 p.m.-5:54 p.m.

Tech Tool Savvy for Physics Teachers, Cathy Ezrailson

Did Faraday and Hertz Do Handson: A Systematic Way To Approach Experimental Work in a Physics Classroom, Eugenia Etkina

How You Can Get More Time To Teach Your Curriculum, Tracey Means

Using Assessment Data To Inform Instruction, Kathleen Falconer

Preparing Accomplished Teachers through a Masters of Natural Science Program, Christina Keller

Preparing Elementary Education Majors for all the Sciences, Thomas Foster

Bringing Inquiry to the Pre-college Classroom through Research-based Professional Development, Donna Messina

Challenging Learning Assistants with Development of Representations of Student Thinking, Hunter Close

Progress in Modernizing the Large Physics Course for Engineers

3:30 p.m.-5:54 p.m.

The Evolution of Introductory Physics at Washington University, Rebecca Trousil

Implementing Curricular Reform in Introductory Physics Courses at Georgia Tech, Michael Schatz

Experiences in Teaching and Coordinating Matter & Interactions at Two Universities, Matthew Kohlmyer

Bringing Introductory Physics into the 21st Century at Purdue, Mark Haugan

Research on Student Learning in Upper Division Courses

3:30 p.m.-5:54 p.m.

Using Research to Enhance Student Learning in Intermediate Mechanics, Bradley Ambrose

Research on Student Learning of Upper-Level Thermal and Statistical Physics, John Thompson

Improving Students' Understanding of Quantum Mechanics, Chandralekha Singh

A Research-based Approach to Transforming Upper-Division Electricity & Magnetism, Steven Pollock

Exploring the Nation's Attic

3:30 p.m.-5:54 p.m.

The Overhead Projector—Glimpses from the Smithsonian Collections, Peggy Kidwell

Joseph Henry and his Electromagnets in the Classroom, Roger Sherman

Exploring the Nation's "The National Physics Course" Attic, Steven Turner

Interesting Things About Isaac Newton, Scott Beutlich

The Use of Causal Warrants in Physics, Luke Conlin

Exploring the Nation's Pivotal Ideas of Physics Attic, Genrikh Golin

How to Advocate for Science Locally, Regionally, and Nationally

3:30 p.m.-5:54 p.m.

Advocating from the Classroom, Francis Slakey

Science, Society, and Social Networking, Kasey White

How to Advocate for Science Locally, Regionally, and Nationally, Ben Wiehe

Lessons Learned from Year of Science 2009 - Now What?, Jennifer Collins

Tuesday, February 16

Selling Physics Research & Education to Congress

10:45 a.m.-12:33 p.m.

Communicating Science Issues to Congress, Ronald Kelley
Selling Physics Research and Education to Congress, Dahlia Sokolov
Supporting Research: A Scientist's View from Inside Congress, Elaine Ulrich
Driving the Point Home – Science Must Be on America's Agenda, Michael Lubell

The Art and Science of Astronomy

10:45 a.m.-12:33 p.m.

Matter in Motion and the Art of Gravity, John Dubinski
The Art and Science of A Voyage through Art-Space Astronomy, Donna Young

Computational Physics in the Undergraduate Curriculum

10:45 a.m.-12:33 p.m.

OSP Modeling: Tools and Resources, Wolfgang Christian
Undergraduate Computational Physics at Penn State—Research Experiences and Coursework, Richard Robinett
Modeling Proteins—with Numbers and Toobers, Tim Herman

Funding Opportunities for Informal Science Education and Outreach

10:45 a.m.-12:33 p.m.

Materials Research at NSF: Educational and International Opportunities, Daniele Finotello
Funding Opportunities for Informal Science Education and Outreach, Sylvia James
Reaching out for Outreach: The University/Science Center Connection, Steven Snyder

Classroom Activities in Particle Physics for the High School I

10:45 a.m.-12:33 p.m.

Yes, Particle Physics! Now, What?, Michael Fetsko
Integrating Particle Physics into the High School Curriculum, Deborah Roudebush
Particle Physics Masterclass: Possibility for Learning About the Nature of Science?, Michael Wadness
The Particle Physics Masterclass, Shane Wood
Introducing Elementary Particles in the Classroom, Helio Takai

Lecture/Classroom

10:45 a.m.-12:09 p.m.

Teaching a Course on Gender and Physics, Amy Bug
Toward Classroom Gender Equity: What Behavioural Science Can Teach Physicists, Kimberley Kreuzer
Science and Pseudoscience, A High School Course, Richard Taylor
Implementing the SCALE-UP Pedagogy in an Algebra-Based Physics Course, Larry Medsker
Teaching Special Relativity: Correcting Misconceptions, Stuart Gluck
The Science of Sound: A Special Education Course, Randy Carbo
Physics Applications from New York Times News, John Cise

Physics Education Research Around the World I

10:45 a.m.-11:57 a.m.

Understanding and Addressing the Dilemmas of Physics Teaching: On Teaching Newton's First Law of Motion, Gyounggho Lee
Understanding of Physical Concepts Based on a Versatility of the Change in Physical and Mathematical Representations, Sergio Flores

PER: Problem Solving

10:45 a.m.-12:33 p.m.

Assessing Student's Ability to Solve Textbook-Style Problems: Update, Part I, Jeffrey Marx
Assessing Student's Ability to Solve Textbook-Style Problems: Update, Part II, Karen Cummings
Building Problem Solving Strategy for Algebra-based Undergraduate Students in UW-Stout, Yuanjia Hong
Using an ECR Framework to Characterize Problem Difficulty and Problem-Solving, Elizabeth Gire
Applying a Framework for Assessing Efficiency and Innovation in Problem Solving, N. Sanjay Rebello
Explaining Student Expertise with Mathematical Sense-Making, Eric Kuo
I'm Doing What My Teacher Says, Why Aren't I Expert-Like?, Michael Hull
The Role of Affect in Stabilizing Wanda's Approach Toward Circuits, Brian Danielak
Affect and Identity in Engineering Students' Approaches to Learning, Problem-Solving, Ayush Gupta

Art and Physics

3:30 p.m.-5:42 p.m.

Hidden Harmony: The Connected Worlds of Physics and Art, Jack Leibowitz
Physics in the Arts, Pupa Gilbert
Symmetry and Aesthetics in Contemporary Physics: An Interdisciplinary Arts-and-Physics Curriculum, Jatila van der Veen
Racing Horses and Cars: Photography and the Perception of Motion, Kenneth Mendelson
Using Keynote as an Artistic Medium, Jeffrey Wetherhold

Instructional Resources for Physics Teacher Education Programs

3:30 p.m.-5:54 p.m.

Seeing the Growth of Physical Theory in Students' Minds, Dewey Dykstra, Jr.
Experiences from a Physics Professional Development Grant Program for Teachers, Nancy Donaldson
Teacher Education and Professional Development Programs in Massachusetts, Esther Zirbel
Restructuring Physics Teacher Preparation -- Teacher Advisory Boards, Field Experience, Induction, Duane Merrell

Panel: Preparing Graduate Students for Careers in College Physics Teaching

3:30 p.m.-4:30 p.m.

Speakers: MacKenzie Stetzer

Classroom Activities in Particle Physics for High School II

3:30 p.m.-4:30 p.m.

Starting Introductory Physics With a Bang!, Rachel Wyatt
Particle Physicists for a Day? How Students Collaboratively Analyze Cosmic Ray Data, Thomas Tomaszewski
Nuclear Forensics Unit for High School Students, Daniel Crowe
Pedagogical Strategy for Implementing an Inquiry-based Fusion Simulation, Thad Zaleskiewicz
Perimeter Institute's Educational Video on Quantum Physics for High Schools, Damian Pope

Physics Majors: High School thru Doctorate

4:42 p.m.-5:06 p.m.

Accreditation, Recruitment, and Retention, Daryao Khatri
Understanding Doctoral Completion Time and its Impact on Career, Geoff Potvin

Enriching Physics in the Classroom and Beyond

3:30 p.m.-5:54 p.m.

Julian Schwinger, Inventor of Renormalized Quantum Electrodynamics: Restoring His Rightful Place in Physics Education, Kimball Milton
New York Physics and Physicists: From the Five Boroughs to the Manhattan Project, Benjamin Bederson
Tales of Fermilab: Achieving Robert R. Wilson's Vision and Leon M. Lederman's Reality, 1967-1989, Adrienne Kolb
I. I. Rabi: Science as the Center of Education Enriching Physics in the Classroom and Beyond, Michael Day

NSF Course Curriculum & Laboratory Improvement Grant Report

3:30 p.m.-5:30 p.m.

NSF's Course, Curriculum, and Laboratory Improvement (CCLI) Program, Duncan McBride
Writing a Competitive CCLI Proposal, John Mateja
Integrating Laser Tweezers into the Introductory Physics Curriculum, Mark Reeves
Development and Validation of the Calculus Concept Inventory, Jerome Epstein
Single Photon Quantum Mechanics: An NSF CCLI Progress Report, David Jackson
Diode Lasers as a Platform for Updating the Advanced Laboratory, Eric Wells

Joint AAPT/APS Session on Physics and Society Education

3:30 p.m.-5:54 p.m.

Moving Toward Sustainable Energy, John Roeder
Perspective from a Policy Physicist, Charles Ferguson
Can Science Help Counter Suspicion of the Consequences of Climate Change?, Gordon Aubrecht, II
Renewable Energy from the Science House: Smart Grid for 6-12, Lisa Grable
Hooking Kids with Haunted Physics, Patricia Sievert
Ethics Instruction in Undergraduate Physics and Astronomy, A. Bacher

How Current and Emerging Educational Technologies Can Support Physics Teaching

3:30 p.m.-5:30 p.m.

The Physics Classroom Website as a Teacher and Student Resource, Tom Henderson
Data Collection Outside the Box, Paul Kuhlman
Using Recordings and Lecture Quizzes in an Introductory Physics Course, Taha Mzoughi
Whole-class Laboratories with Google Docs, Scott Bonham
A Calculus-based Introductory Physics Text Based on Symbolic Computation Software, Brad Trees
Learning Physics with CALM (Computer Assisted Learning Method), Jay Tasson

Improving Physics Teaching by Studying Thinking & Learning in Scientific Domains: A Session Honoring Fred Reif

3:30 p.m.-5:54 p.m.

Striving for a Scientific Approach to Science Education, Frederick Reif
A Knowledge Integration Perspective on Learning and Teaching Physics, Bat-Sheva Eylon
Implication of Memory Models for Physics Problem Solving, Edward Redish
Making Problem Solving a Valuable Learning Opportunity -- An Instructors' Perspective, Edit Yerushalmi

A Physics Teacher's Introduction to Research Frontiers at the National Institute for Standards and Technology (NIST)

3:30 p.m.-5:18 p.m.

Research with Laser-Cooled Atoms at NIST, Paul Lett
Neutrons at NIST, Dan Neumann
NIST's Center for Nanoscale Science and Technology: New Research Opportunities, Robert Celotta

Physics of Hobbies

7:00 p.m.-7:48 p.m.

Physics in Crosswords, William Hogan
The Physics of High Altitude Ballooning, Erick Agrimson
Physics of Running, Renee Lathrop
Why Jerry Jones Needs a Lesson on Projectile Motion, James Moore

Astobiology: From the Frontiers to the Classroom

7:00 p.m.-8:48 p.m.

The Crowded Universe: The Search for Living Planets, Alan Boss
Mars Organic Molecule Analyzer (MOMA): Instrument Concept and Results, Luann Becker
Oases in the Desert of Space, Jason Maron

Using Undergraduate Students in Undergraduate Curriculum

7:00 p.m.-8:24 p.m.

Re-conceptualizing Undergraduate Education: LA Programs as an Experiential Learning Models, Valerie Otero
Recruiting More Majors and Teachers: Undergraduates Are Key, Gay Stewart
Evolution of Student Teaching Assistants in Calculus-based Introductory Physics Courses, Paul Ashcraft

Vertical Alignment of Physics Conceptual Curriculum

7:00 p.m.-8:48 p.m.

Learning About Energy in K-8, Fred Goldberg
Conceptual Alignment, the Spiral Approach and Development of Reasoning, Dean Zollman
Vertical Integration in a Secondary Science Curriculum, Kathy Malone

Successes/Challenges with SPS in TYCs and Small Departments

7:00 p.m.-8:48 p.m.

Maintaining an Active SPS Chapter in a TYC Setting, Jesse Cude
Overcoming Challenges Facing SPS Chapters at Two-Year Colleges, Ajay Narayanan
SPS and the SWTJC Physics Program, Mary Beth Monroe

Teaching Physics to Students with Special Needs

7:00 p.m.-8:12 p.m.

Teaching Learning Disabled Students Taught Me About Inertia and Momentum, Mark Moverman
Does Physics First Include Special Needs Students?, Rose Young
Twice-Exceptional Students in the Physics Classroom, Karen Weeks
Effectiveness of Physics Teaching Based on the Parallel Curriculum Model, Minjung Park
Process Oriented Guided Inquiry Learning (POGIL) Approach in a Diverse Class, Criselda Belarmino
Formula Recollection Through a Wordly Recognized Mnemonic Technique, Shannon Schunicht

Teaching w/Technology II

7:00 p.m.-8:48 p.m.

Using Sound Recording To Teach Fourier Analysis and Wavelet Analysis, Joseph Trout
An Evaluation of the Effectiveness of Using Turning Point Software in the Teaching of Modern Physics, R. Seth Smith
Using Computer Tutorials to Teach Important Lab Skills, David Groh
Computational Exercises in Introductory Mechanics, Marcos Caballero
Use of Rensselaer Mobile Studio IOBoard Hardware and Software in Introductory Physics, Peter Persans
Wolfram Alpha in the Physics Classroom, David Morgan
Enhancing Student Learning: Using Tablet PCs in Modern Physics Class, Marina Milner-Bolotin
Enhancing Students' Learning: Using Tablet PCs in Electricity and Magnetism, Tetyana Antimirova
Integration Can Explain Physical Laws with the Help of Technology, George Kontokostas

Teaching Physics Around the World I

7:00 p.m.-8:48 p.m.

Sharing PER and Physics Teaching in Mexico and with Tibetan Buddhist Monks In-Exile, Dewey Dykstra, Jr.
Developing a Nuclear Questioning Curriculum, Donald Franklin
Conceptual Understanding of Entering University Students in Five Spanish-Speaking Countries, Genaro Zavala

PER: Student Reasoning

7:00 p.m.-8:36 p.m.

The Semantics of Math in Physics, Edward Redish
Students' Views of Data Collected from Physical and Virtual Manipulatives, Jacquelyn Chini
Identifying Conceptual Schema Adaptation Using Similarity Ratings in Algebra-based Physics, Frances Mateycik
How Students Reason about Competing or Enhancing Effects, Andrew Boudreaux
Exploring Students' Patterns of Reasoning, Mojgan Matloob Haghani
Ebb and Flow of Student Knowledge in Introductory Physics, Jessica Clark
An Example of Material Influence on Student Behavior and Thinking, Brian Frank
Hunting for Questions: Developing Metacognitive Strategies in Science Education, Hani Dulli

Wednesday, February 17

Upper Division & Graduate

8:30 a.m.-10:18 a.m.

Implementing JiTT-based Worked Examples in Intermediate Physics Courses, Brian Patterson
Emphasizing Written and Oral Presentation in Graduate Astrophysics Courses, Eric Gawiser
Qualitative Understanding of Magnetism at Three Levels of Expertise, Jill Marshall
Visualizing Tensors with VPython, Roberto Salgado
Nano-Bio-Med-Comp It's All Physics!, Michael Schillaci
A New Curriculum for Physics Graduate Students, Harald Griesshammer
Lessons in Physics from a Study of Hexapedal Entomometry, Saami Shaibani
Geometric Algebra and the Fundamental Theorem of Calculus, Gene McClellan
Understanding of Inductance at Three Levels of Expertise, Francesco Stefani

Teaching Physics Around the World II

8:30 a.m.-9:42 a.m.

Space Science Initiatives for STEM Education Betterment, Norma Reis
Analogy and Structure in The Karlsruhe Physics Course, Corrado Agnes
Potential Calculation for Generally Symmetrical Body Electrified by Superposition Principle, Chengjin Li
A Learner-Centered Approach to Teaching of Physics, Oleg Vorobyev
Teaching Physics Learning Through Researching at High School Level, Que Pham
A Master's Degree Program for High School Teachers in Mexico, Jorge Barojas

Physics Education Research: Solved Problems and Open Questions

8:30 a.m.-10:18 a.m.

Surveying the Conceptual and Temporal Landscape of Physics Education Research, David Meltzer
Physics Education Research: Responses to Changing Course Goals and Demographics
Physics Education, Stephen Kanim
Can Implicit Learning Help Students To Learn Scientific Concepts?, Andrew Heckler

Physics Education Research in the High School

8:30 a.m.-10:18 a.m.

Using a Synthetic Tutor To Build and Assess Knowledge, Chris Nakamura
Preliminary Results of a Physics First Program Evaluation, Elisaveta Bachvarova
Comparing Backgrounds and Physics Experiences of Minority and Non-Minority Students, Charity Watson
Measuring Up: Assessing Student Learning in Physics Union Mathematics Curriculum, James Finley
Student Responses to a Multiple Representation Problem, Tara Bartiromo

Uncovering High School Students' Ideas about Energy,
Cari Herrmann-Abell

Time Dependence of Students' Homework Habits, Peter Knipp
Identifying Student Models of Collisions, Nattakit Sawadthaisong
*Examining Physics Career Interests: Recruitment and Persistence
Prior to College,* Zahra Hazari

Policy and Women

8:30 a.m.-10:18 a.m.

Women Into Physics: Why So Slow?, Shirley Malcom
Policy and Women, Judy Franz
Science Policy: Its Creation and Execution, Patricia Dehmer

New Results in Astronomy Education Research

8:30 a.m.-9:54 a.m.

*Reforming Introductory Astronomy Using SCALE-UP Pedagogy and
Principles of Learning,* Carol O'Donnell
How Old Is Your Universe? Bridges and Barricades for Learning,
Richard Gelderman
Student Understanding of and Attitudes toward Pluto's Reclassification,
Joseph Kozminski
The Galaxy Zoo Phenomena: Exploring Why People Are Engaging,
Trent Mankowski
Astronomy On-Line—Boon or Boondoggle?, Terrence Flower
Exploring Metacognitive Visual Literacy Tasks in Learning Astronomy,
William Dwyer
*The Impact of Stereo Display on Student Understanding of Phases of the
Moon,* Ramon Lopez

Reflections on and Outcomes of the Topical Conference on Advanced Laboratories

8:30 a.m.-10:18 a.m.

A Growing Quest: Open-Ended Projects in Advanced Labs,
Richard Peterson
Striking Responses from Advanced Lab Instructors—and New Initiatives,
Gabriel Spalding
The State of the Traditional Advanced Lab Course, Randolph Peterson

Pre High School Reform Curriculum for Teacher Preparation

8:30 a.m.-10:18 a.m.

*Physics and Everyday Thinking and Physical Science and Everyday
Thinking,* Steve Robinson
Facilitating Inquiry by Using Powerful Ideas in Physical Science (PIPS),
Patsy Ann Johnson
*Physics by Inquiry: A Research-based Approach to Preparing K-12
Teachers To Teach Science as a Process of Inquiry,* Paula Heron

Learning Science in Informal Environments: People, Places & Pursuits

8:30 a.m.-10:18 a.m.

Frontiers in Astrophysics

11:00 a.m.-12:33 p.m.

Hubble's Diamonds: Searching for the Oldest Stars in the Galaxy,
Jason Kalirai
X-rays from Galaxies Teeming with Black Holes and Neutron Stars,
Ann Hornschemeler
Why Should We Care about Dark Energy in our Universe?,
Stephon Alexander

Physics Education Research Around the World II

11:00 a.m.-12:48 p.m.

Peer Instruction: What Group Structure Works Best?, Nathaniel Lasry
*Comparison of Undergraduate Physics Education in U.S., Spain, and
India,* Nandini Banerji
*How Do the Junior Secondary Students Develop Scientific Research
Questions in Open- Inquiry Activity?,* Jongsook Kim
*Web-based Collaborative Teaching of Astrobiology in the EU
ProjectCoReflect,* Andreas Redfors
Recent Trends in Physics Education Research in Japan, Roy Lang
Beliefs about Physics in Saudi Arabia Before and After Instruction,
Hisham Alhadlaq
Physics Teaching by Concept Mapping, Nilüfer Didis
Solving Problems in Physics with Critical Thinking Development,
Ignacio Laiton

PER: Investigating Classroom Strategies

11:00 a.m.-12:48 p.m.

*Developing Scientific Reasoning Abilities through General Education
Courses,* Sachiko Tosa
Faculty and Student Views on Collaboration in the Science Course,
Geraldine Cochran
Students' Mathematical Difficulties in the Physics Lab,
Maria Ruibal Villasenor

Optics in the Upper- Level Curriculum

11:00 a.m.-12:48 p.m.

*Integrating Undergraduate Optics Research with the Traditional
Teaching Curriculum,* Janice Hudgings
Engaging Students in Optics, Mark Masters
Beyond Rays and Waves: Expanding the Reach of Optics, Thomas Brown

Labs/Apparatus

11:00 a.m.-12:48 p.m.

AMS Pressure Blocks (Why is the Air Heavy Today?), Sarah Wendel
Physics on the Cheap—Build with Your Students, Lally Sean
What You Can Learn From a Discarded Microwave Oven,
William McNairy
An Interesting Optical Illusion with Diffraction Glasses, Robert
Schwartz
Rolling to a Value for the Acceleration of Gravity, Bruce Weber
Pre-lab Videos: Digital-Age Solution to an Ancient Problem,
Mickey Kutzner
USB Hall Probe Straight Wire B Field Measurements, S Clark Rowland
Laboratory Development for Physics of Living Matter Course,
Vanalet Rusuriye
Experimental Proof of Malus' Law Using Photoelectric Current,
Karen Williams

Applications of Supercomputers in Astronomy

11:00 a.m.-12:48 p.m.

Supercomputer Simulations of Dust In Extrasolar Planetary Systems,
Marc Kuchner
Rotational Breakup as the Origin of Small Binary Asteroids,
Derek Richardson
Merging Black Holes, Joan Centrella

Post Deadline Session

11:00 a.m.-12:48 p.m.

The Interactive Science Museum as a Laboratory Experience,
Helen Briggs

Modeling Applied to Problem Solving, David Pritchard

Toward an Inventory Assessing Expert Problem-Solving Skills,
Andrew Pawl

Research on Student Model Formation and Development in Physics,
Mark Lattery

Putting Energy and the Environment into Physics, S. Hakan Armagan

Teaching Physics to Animation Artists, Alejandro Garcia

*Service-learning Outreach Activities as a Tool for Enhancing
Undergraduate Learning*, Alice Hawthorn Allen

Service-learning Physics Labs with Elementary-School Outreach,
Carolyn Sealfon

City of Physics—Exploring the Limits, A. Tabor-Morris



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Recognizing Laser's 50th Anniversary

**Public Lecture: *From Edible Lasers and
the Search for Earth-like Planets
Five Decades of Laser Spectroscopy***

Monday, February 15, 7:00 p.m. - 8:30 p.m.

Theodor W. Hänsch

Recipient of the 2005 Nobel Prize in Physics with
John L. Hall

Director, Max-Planck-Institute für Quantenoptik
Professor of Experimental Physics and Laser
Spectroscopy, Ludwig-Maximilians Universität
München, Germany

To hear more about the laser, check out these sessions:

**NSF Course Curriculum & Laboratory Improvement
Grant Report**, Tuesday, 3:30 p.m.-5:30 p.m.

*Integrating Laser Tweezers into the Introductory Physics
Curriculum*, Mark Reeves

*Diode Lasers as a Platform for Updating the Advanced
Laboratory*, Eric Wells

**A Physics Teacher's Introduction to Research Frontiers
at the National Institute for Standards and Technology
(NIST)**, Tuesday, 3:30 p.m.-5:18 p.m.

Research with Laser-Cooled Atoms at NIST, Paul Lett

Fourth Annual

SYMPOSIUM on Physics Education

Educating Physics Teachers: A Call to Action for Physics Departments

Dedicated to the memory of Len Jossem.

**At the APS/AAPT Joint Meeting • Tuesday, February 16, 1:30–3:18 p.m.
Washington Marriott Wardman Park • Washington, D.C.**

Science Teaching as a Profession. Why it isn't. How it could be. Sheila Tobias
Teacher Preparation – UTeach. Mary Ann Rankin

*Transforming the Professional Preparation of Physics Teachers in the United States:
Findings and Recommendations of the T-TEP Report*

Stamatis Vokos, Chair of the Task Force on Physics Teacher Preparation

*Sponsored in part by the PhysTEC Project,
an NSF-funded partnership of APS, AAPT and AIP.*

