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APS physics

New Series on Versatility in Physics debuts on page 5

New Research in Particle, Nuclear and Astrophysics Featured at April Meeting

The latest research results in particle, nuclear, plasma, and astrophysics will be featured at the upcoming 2007 APS April Meeting, to be held April 14-17, 2007 in Jacksonville, Florida. Among the many notable speakers on the program are 2006 physics Nobelists John Mather (NASA) and George Smoot (Lawrence Berkeley National Laboratory), who will discuss their prize-winning work on the cosmic microwave background. In addition, there will be a wide variety of sessions devoted to education, national security, energy research, and other social issues.

Three plenary sessions (A1, Q1, W1) will spotlight eminent speakers holding forth on the leading topics of the day. Francis Everitt (Stanford) will present new results form the Gravity Probe B mission. Allan MacDonald (University of Texas) will describe the amazing properties of electrons moving about in a two-dimensional graphene sheet. Gerald Gabrielse (Harvard) will discuss his new measurement of the electron's magnetic moment, which resulted in a new value for the fine structure constant. David Spergel (Princeton) will review the implications for cosmology of the WMAP mission, which provided recently such a fine map of the cosmic microwave background.

LBL Director Steven Chu will discuss the role played by physicists in the development of clean energy sources. Shamit Kachru (Stanford) will look at how string theory addresses the idea that many universes might exist simultaneously, each with its own fundamental "constants." Jacqueline Hewitt (MIT) will speak about the early "dark age" in the universe; James Hansen (NASA Goddard Institute for Space Studies) will discuss global warming and its possible side effects; and Steven Vigdor (Indiana) will report on recent proton spin results from the Relativistic Heavy Ion Collider (RHIC).

Putting a Spin on the Proton. The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory has been tak-

APRIL MEETING continued on page 6

APS Panel Report Assesses Nuclear Waste Storage Issues

Approximately 54,000 tons of spent nuclear fuel are stored at operating nuclear power plants and several decommissioned power plants throughout the country. The APS Panel on Public Affairs (POPA) has recently released a report assessing some of the issues involved in developing one or more consolidated interim storage sites where this nuclear waste could be stored until a permanent repository at Yucca Mountain is opened.

Current storage facilities at reactor sites were not meant to be permanent, but the schedule for opening Yucca Mountain continues to slip. The federal government is incurring increasing liability costs the longer spent fuel remains at reactor sites, and there is concern that continuing to store spent fuel at power plants will make it more difficult to find sites for new nuclear power plants and to build them.

Recently, appropriations committees in Congress have suggested building one or more consolidated interim storage sites for the spent fuel. The POPA Nuclear Energy Study Group examined issues associated with the centralized interim storage of spent nuclear fuel and has issued a technical and programmatic assessment.

"We found no major technical benefit to developing a consolidated interim storage site," said John Ahearne, one of the study group co-chairs. There may be some programmatic benefits to a consolidated storage site, he said.

One advantage of a consolidated storage site is that it could "relieve impediments to the growth of nuclear power," the report says. A consolidated site would decouple the private sector nuclear power plant operators from uncertainties inherent in the federal long-term spent fuel management program, the report notes. "The assurance that spent fuel can be removed from a reactor to a storage site may reduce the difficulty in siting new plants," the report says.

The study group determined that there are no technical barriers to long-term safe and secure interim storage either at nuclear reactor sites or at a consolidated site. "The safety and security risks associated with storage of spent fuel are not appreciably different whether the fuel is stored at plant sites or in one or more consolidated facilities," the report states.

Even if Yucca Mountain opens as scheduled in 2017, it will take several decades to move all the currently stored spent fuel to the site. Interim storage, either at reactors or at one or more consolidated sites, will still be necessary, the study group reports. The study group also found that there is sufficient storage capacity at current nuclear reactors to hold all spent fuel for the duration of the plant licenses.

If Congress decides to develop a consolidated interim storage facility, there will be challenges in selecting and approving a site. However, the study group suggests that these siting challenges can be overcome by finding ways to make the facility

POPA continued on page 4

Four New Sites Added to Teacher Education Program

PhysTEC, the APS-led program to improve teacher education, has announced the addition of four new sites.

PhysTEC (Physics Teacher Education Coalition) institutions work to demonstrate and provide models for increasing the number of highly qualified high school physics teachers and improving the quality of K-8 physical science teacher education. PhysTEC also aims to spread best practice ideas throughout the community and work toward transforming physics departments to re-engage in the preparation of physics teachers.

The PhysTEC project is led by the APS, in partnership with the American Association of Physics Teachers and the American Institute of Physics.

Interest in the PhysTEC program has been extremely high. When PhysTEC sent out an initial request for proposals for expansion sites in October 2006, it received 45 applications, many more than expected.

"Project management was quite delighted and a bit overwhelmed by the interest in this program–clearly physics and physical science teacher education is gaining momentum among institutions around the country," said Ted Hodapp, APS Director

PHYSTEC continued on page 3

Named Lectureships Enhance March and April Meetings

Several named lectureships are bringing distinguished speakers to the APS March and April meetings this year.

The Henry Primakoff Lecture will be given at the 2007 April Meeting by John Wilkerson of the University of Washington. The Lectureship was established in 1997 by the APS Council and by colleagues of the late Henry Primakoff to honor his contributions to physics. Wilkerson will speak about double beta decay, which had been a topic of particular interest to Primakoff, who was the author, together with the late Peter Rosen, of a classic paper on the subject [*Rep. Prog. Phys.* **22**, 121 (1959)]. Said Wilkerson, "The Primakoff and Rosen paper is one of the seminal early papers on double beta-decay, which I recall first reading as a postdoc just starting to learn about weak interaction physics. With the recent evidence that neutrinos have mass, Primakoff's work in this area has renewed relevance and makes for a fitting and timely lecture topic."

In addition, two named APS lectureships are bringing four distinguished foreign scientists to speak at the March and April meetings. The Beller Lectureship was endowed by Esther Hoffman Beller for the purpose of bringing distinguished physicists from abroad as invited speakers at APS meetings. The Marshak Lectureship, endowed by Ruth Marshak in honor of her late husband and former APS president, Robert Marshak, provides travel support for physicists from a developing country or from Eastern Europe invited to speak at APS meetings.

For 2007, two Beller Lectures were given at the March Meeting. Eliezer Rabinovici of Hebrew University in Jerusalem, spoke on "SESAME, A Scientific Collaboration In The Middle East: Personal and Israeli Perspectives." Rabinovici was nominated by the

LECTURESHIPS cont. on page 6

Major Donation Launches New Math and Science Education Initiative

A donation of $125 million from ExxonMobil Foundation will support a new program designed to help America regain its global leadership position in technological innovation by supporting programs that improve math and science education. The new program, the National Math and Science Initiative (NMSI), was announced by ExxonMobil and leaders in America's education community on March 9.

The NMSI was created in response to the National Academies' 2005 report, *Rising Above the Gathering Storm*, which called for improving American students' performance in math and science in order to ensure US global competitiveness.

In a press release announcing the creation of NMSI, Tom Luce, CEO of the NMSI and former U.S. Assistant Secretary of Education for Planning, Evaluation, and Policy Development, said, "The National Academies set forth a clear path for the nation to improve math and science education for our country's youth and it is now time for us to act."

The NMSI will scale-up two existing programs. One is training and incentive programs for AP and pre-AP courses. [The AP, or

DONATION continued on page 7

Who's Got the Gavel?

Photo by Ken Cole

From the picture, you might think that APS decides its presidency the same way that teams are chosen in a sandlot baseball game. That is an illusion, however. John Hopfield (right), who was President of APS in 2006, is handing the gavel, symbolic of the APS Presidency, to 2007 President Leo Kadanoff. The transfer took place at the APS Executive Board meeting in Ridge, NY in February, although Kadanoff had been President since January 1.

Members in the Media

"For 28 years, we've done what we wanted to do, and there's no reason to stay and generate more of the same data. If people don't believe us after all the results we've produced, then they never will."

***Robert Jahn**, Princeton University, on the closing of Princeton's engineering anomalies lab, which studied paranormal phenomena, The New York Times, February 10, 2007*

"I don't believe in anything Bob is doing, but I support his right to do it."

***Will Happer**, Princeton University, on Robert Jahn's studies of paranormal phenomena, The New York Times, February 10, 2007*

"I get a huge range of questions. Kids read up before they come here and ask about Einstein and relativity. It's very surprising."

***Michael Cooke**, Fermilab, on visitors to Fermilab, the Daily Herald (suburban Chicago), February 12, 2007*

"You can't buy a $20 phone without being offered an extended warranty. If you said 'No' every single time, you would save more than enough in the long run to pay for the few repairs you actually need."

***Joseph Ganem**, Loyola College, Baltimore Sun, February 18, 2007*

"It doesn't feel like playing a game; it doesn't feel like chess; it doesn't feel like solving a puzzle; puzzles are invented by humans. In physics, there's a sense of discovery, and what it contains is far beyond what we imagined we could have imagined."

***Nima Arkani-Hamed**, Harvard University, on what motivates scientists, the Globe and Mail, February 12, 2007*

"Elegant laws of physics give you boring universes that don't have anything in them."

***Joe Lykken**, Fermilab, Washington Post Magazine, February 18, 2007*

"If we're going to delay global warming, what we can do in a big hurry is energy efficiency: better cars, better buildings, better industry."

***Arthur Rosenfeld**, California Energy Commission, Washington Post, February 17, 2007*

"It leads you to wonder whether they kind of got lucky. But the fact remains that the patterns are tantalizingly close to having the structure that Penrose discovered in the mid-70s."

***Joshua Socolar**, Duke University, on a study that found that some medieval Islamic art exhibits sophisticated geometrical patterns, Reuters, February 26*, 2007

"Bubble chamber pictures have played an important role in conveying science without oversimplifying the fundamentals. It's like, 'What you see is what you get.' These pictures are, in my mind, masterpieces of nature's abstract art."

***Vivek Sharma**, UC San Diego, San Diego Union-Tribune, March 1, 2007*

The Rocky Mountain News asked several March Meeting attendees the following question: "What is it in day-to-day life that baffles you?"

"Balancing my checkbook. We do so much math in our work that I've almost forgotten how to do the basic stuff, like trying to figure the tip at the restaurant last night. It was ridiculous. We had eight people there, and everybody pulled out their calculator."–***Mark Patty**, University of Missouri*

"I was helping my brother bleed the master cylinder on his truck. It should have been a simple problem to understand, but the solution was to take it to a garage and let them do it."–***Christopher Ashman**, Naval Research Lab*

"I find myself being awkward and having difficulty in conversation and in dealing with people. . . . I laugh a lot. I find random things funny, and I just start laughing out of nowhere. And people look at me like I'm crazy. I enjoy laughing."–***Mary E. Mills**, College of Wooster*

"I find it very interesting how cities work. There are a lot of people. And, from this, certain structures emerge. It somehow puzzles me because it's structure out of chaos, and you can see this everywhere." –***Michael Buettner**, University of Virginia*

"The way people interact. People are impossible to understand."– ***Michael Garrett**, University of Calgary*

This Month in Physics History

April 1911: Heike Kamerlingh Onnes begins his work on superconductivity.

This year, 2007, the physics community celebrates the 20th anniversary of the "Woodstock of Physics" conference on high temperature superconductors and the 50th anniversary of the BCS theory of superconductivity. However, the story of superconductivity begins in 1911, when Heike Kamerlingh Onnes first discovered the phenomenon.

Kamerlingh Onnes was born on September 21, 1853, in Groningen, in the Netherlands. His father owned a bricklaying business. Onnes entered the University of Groningen in 1870, spent two years in Heidelberg from 1871 to 1873, and then returned to Groningen, where he received his doctorate in physics in 1879.

Onnes, known as "the gentleman of absolute zero," devoted his career to a quest to reach lower and lower temperatures and explore the behavior of matter at those extremely low temperatures. He began that quest in about 1882, when he joined the faculty at Leiden University and started studying low temperature gases. A dedicated experimenter, his motto was "Door meten tot weten" ("Knowledge through measurement").


Heike Kamerlingh Onnes

In 1898 Onnes' rival, James Dewar, beat him in the race to liquefy hydrogen. Onnes then moved on to a new goal, liquefying helium, and this time, Onnes beat Dewar in the race, producing the first liquid helium in July 1908. Though he only liquefied a tiny amount of helium at that time, the liquefaction of helium made it possible to cool other substances to such low temperatures. Onnes managed to cool the liquid to about one degree above absolute zero, at the time the coldest temperature ever achieved.

Liquid helium was difficult to work with, so Onnes spent the next three years developing apparatus for using and storing the liquid helium for use in further studies. Rather than continuing on the quest to reach lower and lower temperatures, Onnes turned his attention to using the liquid helium to study the properties of matter near absolute zero.

In the spring of 1911, Onnes began his studies of electrical conductivity of metals at low temperature. Physicists at the time knew that resistance generally dropped as a sample was cooled, but they had no idea what happened when the temperature reached the extreme lows near absolute zero. Some had hypothesized that resistance would continue dropping slowly, finally reaching zero when the temperature reached zero. Others believed resistance would level off at some constant value. Still others, including Lord Kelvin, believed that near absolute zero electrons would essentially freeze into place and resistance would become infinite. Onnes intended to resolve the question.

Believing that any impurities in a metal would spoil his results, Onnes chose mercury for his studies because he could produce extremely pure samples of the metal. He had been working with gold at the time as well, but selected mercury instead, a fortunate choice, since had he stuck with gold he would not have discovered superconductivity.

Keeping the mercury in a U-shaped tube with wires at both ends, he passed a current through it and measured resistance as he lowered the temperature. At first, as the temperature dropped, the resistance also dropped slowly. Then, suddenly, at 4.19 Kelvin, the resistance abruptly vanished. Onnes was shocked. This was not what anyone had predicted.

At first Onnes didn't believe what he saw; he thought perhaps there was a short circuit or some other problem with the apparatus. He and his team repeated the experiment until finally Onnes became convinced that the surprising effect was indeed real. In late April 1911, he published his first paper, titled "The resistance of pure mercury at helium temperatures" in the Communications from the Physical Laboratory at Leiden. He published a second paper in May, and in November 1911, Onnes published another paper entitled "On the Sudden Change in the Rate at which Resistance of Mercury Disappears."

Soon after finding the effect in mercury, Onnes showed that tin and lead also become superconducting at low temperatures.

Though other physicists did not immediately grasp the importance of the discovery–a presentation Onnes gave at a conference in 1912 generated little excitement–Onnes quickly recognized the commercial potential. He predicted that someday superconducting wires would carry electricity to consumers, providing a cheap and almost unlimited supply of electricity. But Onnes was disappointed within a couple years when he discovered that a supercurrent would be destroyed by even a small magnetic field.

In 1913 Onnes first used the term "supraconductivity," to describe the effect; later he changed it to "superconductivity." By 1914 he had found another interesting feature: he started a supercurrent flowing in a lead wire, and a year later, found that it was still flowing, with no noticeable change.

Onnes won the Nobel Prize in 1913, just two years after his incredible discovery. He was cited for his work in low temperature physics, especially the liquefaction of helium, but not specifically for superconductivity.

Having been in delicate health for much of his life, Onnes died in 1926. For decades after Onnes' initial discovery, no one could explain how the effect worked. Onnes himself had believed that quantum mechanics would explain the effect, but he wasn't able to produce a theory. Finally, in 1957, Bardeen, Cooper, and Schrieffer came up with a successful theory to explain superconductivity. In 1986 Bednorz and Mueller discovered the first high temperature superconductors, a breakthrough that led to an explosion of further research and a nearly all-night conference at the APS March Meeting in 1987 known as the "Woodstock of Physics." Superconductors are used today in levitating trains, MRI devices, in high energy physics, and in some electrical power applications.

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Science Research Budgets

The 109th Congress adjourned last December without passing appropriations bills for most federal programs. On February 14, 2007, four and a half months into Fiscal Year 2007 and with the 110th Congress in session, the Senate finally approved a Joint Resolution that will fund federal agencies through September 30. [Nine days earlier, the President had proposed his budget for the Fiscal Year 2008 (FY 08) that will begin on October 1]. The Joint Resolution, as originally conceived, was going to freeze all federal activities at their FY 06 levels. But after intense lobbying by the science community, congressional leaders agreed to make science one of the very few priorities that received special treatment in the Joint Resolution, providing significant increases for DOE, NIST and NSF Research and Related Activities, as indicated in the table below. Earlier in the fiscal year, Congress had appropriated funds for DOD, restoring some of the cuts, mostly for earmarks, that the White House had previously recommended .

The President's FY 08 Budget request continued the Administration's commitment to the American Competitiveness Initiative (ACI) that proposes to double the aggregate funding for the NSF, the DOE Office of Science and NIST Scientific and Technical Research and Services (STRS) that includes the NIST laboratories and the Malcolm Baldrige Program. With FY 07 funding bills not yet having been enacted, the White House was forced to base its spending plan on the FY 07 presidential request. The three ACI accounts would grow by 7 percent compared to that request and even more compared to the appropriated levels in the Joint Resolution, as indicated in the table. The President's proposed cuts for the DOD research account are largely the result of removing FY 07 earmarks, but even discounting the earmarks, the 6.1 (basic research) and 6.2 (applied research) still would not fare well. The FY 08 request would provide a 0.7 percent increase for the 6.1 program, significantly less than inflation, and a 2.7 percent decrease to the 6.2 program. For NASA science, the request would provide a very modest 0.9 percent relative to the FY 07 request, although comparisons are difficult to make because of re-definitions within the budget.

Account	FY05($B)	FY06($B)	FY07($B)	FY08 Request	
				($B)	% Change***
DOE Office of Science	3.57*	3.47*	3.8	4.4	+15.8
DOE EERE	1.23	1.16	1.46	1.24	-15.6
NSF	5.48	5.59	5.92	6.43	+8.7
NIST STRS	0.37*	0.38*	0.43	0.50	+16.4
NIST ATP	0.14	0.08	0.08	0	-100
DOD 6.1	1.49	1.46	1.56	1.43	-8.7
DOD 6.2	4.79	4.95	5.33	4.36	-18.2
NASA Science	5.50	5.25	5.25	5.52**	NA

* Adjusted for Congressionally Mandated Programs (or Earmarks). ** New budget structure; comparison with previous years is not appropriate. *** % Change from FY07 request.

For details of the FY07 budget process, go to http://www.aaas.org/spp/rd/fy07.htm. For details on the FY08 budget process, go to http://www.aaas.org/spp/rd/fy08.htm.

ISSUE: Panel on Public Affairs Update

At its February 2nd meeting, the APS Panel on Public Affairs (POPA) approved two charges for reports. One will be an assessment of nuclear forensics technology and techniques, and the second will be a study of the status of the United States nuclear workforce that will be chaired by Sekazi Mtingwa of MIT. Both report committees will hold briefing sessions later this year.

POPA is an APS standing committee that is charged with advising the Council and officers of the Society in the formulation of APS positions on public policy issues that have a technical dimension of interest to physicists. POPA also investigates the desirability of APS-sponsored expert studies on physics-related topics of importance to society and helps to organize such studies

ISSUE: POPA Electricity Storage & Interim Nuclear Waste Storage Studies

At its February 2nd meeting, POPA approved the report on interim nuclear waste storage and a policy supplement on electricity storage. Both can be accessed on the POPA Reports website at www.aps.org/policy/reports/popa-reports.

ISSUE: APS CO_2 Reduction Study

At its February meeting, the APS Executive Board approved the establishment of an APS study committee to evaluate the R&D portfolio that would best transition the US to a carbon-reduced economy. The study would focus on end-use energy efficiency. The APS Washington Office is currently pursuing possible chairs and members for the report committee. The report is expected to be completed by early 2009.

Log on to the APS Website (http://www.aps.org/policy) for more information.

Physicists Use Direct Line to Capitol Hill

Photo by Ken Cole

A total of 1235 attendees made use of the bank of computer terminals set up at the March Meeting in Denver to contact their representatives in Congress. With the 2008 Fiscal Year budget cycle just beginning, it was an opportune moment for physicists to weigh in on the importance of funding for the physical sciences. The FY07 budget had just been passed, four and a half months late, a few weeks before (see Washington Dispatch column at left).

Initial Employment is Focus of AIP Report

Where do new recipients of physics degrees find their first jobs? In a February report, the statistical research center of the American Institute of Physics surveys physics bachelors, masters, and PhD recipients about their initial employment. The report covers those who received their degrees in 2003 and 2004.

The economy and other factors influence the initial employment choices of physics degree recipients, the report notes. "The US economy has changed significantly from the strong, technology-propelled successes of the late 1990s," the report says. "Echoes of these broad economic changes can be seen in the initial post-degree status of physics and astronomy degree recipients of all levels."

There has been a significant increase in physics bachelor's degree production in recent years, and more of them are entering the job market, the survey found. After three years of decline, the proportion of new physics bachelor's degree recipients entering directly into the job market has stabilized in 2004. About 41% entered the job market directly, down from a high of about 52% in 2000. In 2003 and 2004, 37% of physics bachelors enrolled in graduate school in physics, and 22% continued their education in other fields.

Those who enter the job market are employed in a variety of employment sectors: 14% are high school teachers, 12% are working in a college or university, 7% enter active military service, and 56% are employed in the private sector. Over two-thirds of those employed in the private sector are working in science, technology, engineering, or math (STEM) positions.

"Recent physics bachelor's who have entered the job market have seen difficulties paralleling the strains in the US economy. However, increasing starting salaries, along with the apparent shift toward more new bachelor's accepting STEM-related positions, may reflect a change to a more positive initial employment outlook for physics bachelor's," the report says. Over three-quarters of new physics bachelor's were pleased with the career prospects available to them, and 86% said they would still study physics if they had to do it over again.

The proportion of new physics PhDs accepting postdocs has risen for the fourth straight year, to 66%. Another 5% accept some other temporary position, and 26% take potentially permanent positions. The remaining 3% were unemployed.

EMPLOYMENT continued on page 7

PHYSTEC continued from page 1

of Education.

Hodapp attributes this interest in teacher preparation in part to recent publicity about science education in America, which has shown that American students perform poorly in science compared to students in many other countries. Several reports in the past few years, including the National Academy of Sciences report *Rising Above the Gathering Storm*, have emphasized the need for improved science education and recruitment of more K-12 science teachers in order to retain our global competitiveness. Physics departments are starting to wake up to the need to produce more, better-trained science teachers, said Hodapp.

The 45 applications to PhysTEC were narrowed to 12 institutions, and 11 of these submitted a 10-page proposal. Four of these were selected to be funded. The new PhysTEC sites are: Cornell University; University of North Carolina at Chapel Hill; Florida International University; and the University of Minnesota, Twin Cities. In addition to the four schools just selected to join PhysTEC, another new school, Seattle Pacific University, joined PhysTEC last fall.

PhysTEC institutions implement several elements that the project has come to recognize as critical to the success of thriving programs. PhysTEC sites engage in active recruiting that gives students–especially those not typically considering teaching as a vocation–an authentic teaching experience, preferably early in their academic career. These schools also offer physics content courses that model instructional methods that prospective teachers could use in their classrooms. Mentoring prospective and new teachers throughout their undergraduate experience and into their first years in the classroom is also an important element of the PhysTEC program.

The PhysTEC institutions use master teachers (called Teachers-in-Residence) to assist in many of the programmatic elements. These individuals make and maintain connections between physics departments, schools of education, and the local school districts. They provide a "peer" contact for prospective teachers and a personal touch that is essential to completing the program and establishing good teaching practice.

Another program that has been used successfully in many PhysTEC institutions is Learning Assistants. Learning Assistant programs serve as a combination of recruiting tool and early teaching experience where undergraduate students who have done well in an introductory physics course are brought back in subsequent terms to help facilitate learning. These individuals also typically simultaneously take a 1-credit course or seminar on instruction and how people learn. "Since everyone teaches someone something in their lives, this can be a significant experience for anyone," said Hodapp.

Many PhysTEC schools also have Teacher Advisory Groups, which typically meet once a semester, to help departments in recruiting the next generation of physics majors as well as future teachers, and provide a peer-mentoring network among the teachers and faculty.

The PhysTEC project has worked with a number of institutions over the past six years, including Ball State University, Cal Poly San Luis Obispo, Oregon State University, Seattle Pacific University, Towson University, University of Arizona, University of Arkansas, University of Colorado at Boulder, Western Michigan University, and Xavier University of New Orleans. Project sites have seen an average of a twofold increase in physics and physical science teachers graduated, with many programs having even more significant gains. Teachers have been evaluated with standardized measures and have scores consistent with those in best-practice interactive learning environments.

In addition to the limited number of funded PhysTEC schools, 70 universities have joined PTEC. PTEC, which grew out of the PhysTEC program, is a larger association of physics departments dedicated to the improvement of K-12 physics and physical science teacher preparation.

Letters

Open Access Unnecessary for Physicists

It was interesting to read why a molecular biologist supports open access [*APS News*, Back Page February 2007]. Interesting but unimportant. He has no idea of how a physicist thinks. When I have an interesting problem to solve, I like to work on it myself and see how far I can get. If I come up with an elegant solution, so much the better. I don't want to first see what others have done and become biased and perhaps fall into the same pitfalls. The only time I access previous articles is when the referee forces me to.

I used to get paper copies of five journals. For lack of space, I have given up on all but two of them. I have open access to all of them, but I have not taken the time to look. Although it is good for archiving, open access doesn't work for current literature except for people who have a lot of time on their hands. Bill Hooker notes that someone has to pay for open access but only says that half the costs comes from fees paid by the authors. He never says where the other half comes from.

Frank Chen
Los Angeles, CA

Simulations Teach Real Physics

I would like to commend Alan Chodos for the column "The Virtues of Virtual Experiments" in the February *APS News*. Among all the good reasons he gave for doing physics on a simulator I would like to emphasize the pedagogical. Events in a real laboratory happen too fast to observe the physics, so you learn lab techniques rather than the physics. I taught AP physics in a Blue Ribbon High School after I retired (part time, temp, since my PhD and years of practice did not qualify me as a Teacher) and the first thing I did was to put a leading physics software package on the server. I was later told that, since this package was available to any student, it received far more hits than any other package in the school system. The ability to assemble pieces and forces and watch the interaction unfold in slow motion animation, was irresistible.

Consider even the first experiment usually done in the lab: measuring g by dropping a weight. I teach g as being approximately 20 miles per hour per second, so in 2 seconds the dropped weight is going 40 miles per hour, too fast for the human eye to observe. On the other hand, watching the weight fall on a simulator, surrounded by virtual instruments showing "real" time and distances while watching in simulated time, with graphs growing, gives a much better gut feeling for acceleration.

Particle collisions and statistical mechanics are much better taught on a simulator. The details of the individual collisions can be seen whereas in the lab the actual collision happens so fast that we only observe the results. Mass ratios, sizes, spin, friction, drag, elasticity can all be changed, easily, so the effects can be seen right away. I admit that the crashing of the carts and having them shoot off the runway is missing. As Chodos points out, simulation teaches electric flow more effectively than the lab. The fascination of drawing a spark from the Van de Graaff cannot be overlooked, nor other dramatic demo effects, but does looking at a computer motherboard teach you any physics?

The present generation has been brought up on computer games and so they just see this as another game but one with realistic interactions. Slow compared to the games, but infinitely more acceptable than the slowness in the lab in which, paradoxically, the main event happens too fast to be seen.

Henderson Cole
Danbury, CT

POPA continued from page 1

more attractive environmentally and economically to the host community. It would be necessary to make sure a consolidated interim site and the Yucca Mountain repository proceed in a complementary way, in a manner consistent with current Federal strategies for long-term nuclear waste management, the study reports. The Yucca Mountain site must not be delayed by an interim site, and it would be necessary to assure the public that an interim site would not become permanent, the report says.

If the Yucca Mountain repository is not delayed significantly beyond its currently scheduled opening, there is no economic benefit to a consolidated interim storage site, the study finds. "There are no compelling cost savings to the Federal government associated with consolidated interim storage," the report states. If, however, Yucca Mountain is significantly delayed, Congress would need to request an independent review to determine whether a consolidated interim storage site would be economically attractive, the report says.

The full report is available online under "Reports and Studies" on the Policy and Advocacy page of the APS web site.

In addition to the nuclear waste storage report, the APS Panel on Public Affairs is conducting research on advancing electricity storage technologies. The POPA Committee on Energy and Environment has recently released a policy supplement on this issue.

The supplement describes promising energy storage technologies and R& D opportunities for developing these technologies. The six technologies are pumped hydropower, compressed air energy storage, batteries, flywheels, superconducting magnetic energy storage, and electrochemical capacitors.

Electricity storage technologies have the potential to reduce the need for reserve power plants, cut the cost of power failures, and enable renewable energy, the supplement says. The committee concludes that the Department of Energy should consider broadening its existing program for electricity storage technologies, while balancing basic research, demonstration projects, and regulatory incentives.

INTERNATIONAL News

...from the APS Office of International Affairs

How I was Helped By Superman

By Geraldo A. Barbosa

The title may lead you to expect a cartoon story. Comical it may be, but it happened in real life. I am one of the few people–perhaps the only person–ever rescued by Superman.

In the late 1970s, I was a professor of physics in Brazil, where I was building an optics laboratory at a federal university. I had graduated from the University of Southern California in Los Angeles, where lasers had already become common laboratory equipment. It was also quite common to encounter problems with these newly created marvels. The laser companies, eager to please and increase their clientele, always helped as much as they could. They replaced defective tubes and fixed electronics at lightning speed. Just a telephone call, and zap! All problems solved.

Back in Brazil, inflation was roaring and the bureaucracy created complex processes for the expenditure of any government funds. For overseas purchases, the red tape was almost impossible to cut through. The simplest request could take more than a year to be approved through an exasperating rigamarole of form-filling, stamps, signatures, and various other formalistic delays designed to forestall expenditures–preferably until the resquestor changed careers or died of old age. Even replacing an item under warranty could take more than a year, and required the same expedition through all the red tape a fertile mind could dream up.

In my lab a new Coherent-brand krypton laser tube proved defective. I called Coherent, explained the problem, and asked them to prepare a replacement. They promised to do everything as fast as possible. I also explained the many Brazilian bureaucratic steps necessary to perform this exchange so they could help meet the requirements.

A few days later my phone rang. An angry customs officer complained that a large box with my name on it had arrived, and that it was presently violating all applicable laws and import policies. Coherent had just placed the new tube in a box and shipped it as they would do in California–without any documentation. This was a mortal sin against our bureaucracy. Apart from storage fees, the volume of supposed illegalities created a huge sum of taxes and fines to be paid. Collecting all possible composure, I tried to explain the whole story and emphasized that this equipment actually belonged to the federal government. Deaf ears. Insurmountable barriers. A serious offense had been committed.

Days passed. I tried phone calls, technical consultations, legal support, but found no sign of a breach in the steel chain around this problem. Even worse, although the address was at the university, it was my name on the box. The problem would crash directly on my head.

I decided to try face to face negotiation. I went to customs to talk to the officer involved. The explanation was simple and, I thought, persuasive: there was no purchase, it was only a replacement. And anyway, it already belonged to the same government that was now in effect trying to tie its own hands and charge itself an import fee. I begged his understanding, and again hit the same brick wall.

In desperation, I demanded a written document. If I could not leave customs with the box at that moment, then I would have to be released from any responsibility in case that fragile tube cracked, leaking the rare krypton gas into the atmosphere where it might contact innocent bystanders. I required that the document would detail my failed attempts to remove this complex piece of equipment from the customs warehouse.

Suddenly this became a delicate situation for the officer–not an expert on rare gases, I hoped. He called a few colleagues aside to deliberate over the problem's new dimensions. I recall glances alternating between the laser-tube box and me, and nervous whispers. I heard one of them speak the words "Kryptonite" and "Superman." A few minutes later, the officer in charge emerged and told me that as a special exception they were going to liberate my equipment, and would I please take it away as soon as possible?

So, do you know anyone else who was ever rescued by a superhero? Got yourself in a tight spot? Blocked by bureaucratic red tape? Call me: I have a friend who can help you.

Geraldo Barbosa is a professor of physics at Northwestern University.

zero gravity

The Lighter Side of Science

Footnotin' Frenzy

By Michael Berube

Editor's Note: *Michael Berube teaches literature and cultural studies at Penn State University. He is the author of the recently published tome* What's Liberal About the Liberal Arts? *Until January, he also maintained an eponymous blog. In this excerpt from an October 2005 entry, he waxes ironical about authorial footnotes and the ongoing tension between science and the humanities as it relates to Thomas Kuhn.*

Even though footnotin' is hard work, it's not all tedium and Googling and visits to the stacks. Not at all! Some of footnotin' involves real argumentin', just in a tinier font at the back of the book.

The last time I got together with my editor, on a weekday evening in a midtown restaurant in New York, he flagged the opening pages of the chapter on my postmodernism seminar and said, "You might want to watch the mention of Kuhn–because, as you know, there are any number of readers out there who are really tired of humanities professors citing Kuhn and getting him wrong. Likewise with Gödel and Heisenberg on 'incompleteness' and 'uncertainty'."

As you might imagine, this remark made me violently angry. Yanking the bottle of pinot grigio from the ice bucket to my right, I smashed it on the edge of the table, stood up, and said, "All right, man. I know all about those readers. And I'm as pissed off about sloppy appropriations of Kuhn as anyone. But let me say one thing."

At this point I had drawn the alarmed attention of all the diners-and-drinkers in the place, not least because I was waving the broken bottle around and making random stabbing motions. "I'll put my reading of Kuhn up against anyone's. Anyone's, do you hear me? DO YOU HEAR ME? I'm serious, man–I don't just go on about 'paradigm' this and 'incommensurability' that, people. I can take Kuhn's examples about phlogiston and X-rays, and I can extrapolate them to Charles Messier's late-eighteenth century catalog of stellar objects, or the early controversy over the determination of the Hubble constant, or the 1965 discovery of the cosmic microwave background radiation by Penzias and Wilson. GET IT? So don't mess with my reading of Kuhn. Any of you."

There were a few moments of silence, punctuated only by some nervous clattering of silverware. Then a conservatively-dressed man in his early fifties got up from a table fifteen or twenty feet away. "People like you," he said, trying to stare me down, "read Kuhn backwards by means of Feyerabend's Against Method, and as a result, you make him out to be some kind of Age of Aquarius irrationalist who thinks that scientists run from paradigm to paradigm for no damn reason." Then he tossed his napkin across the table. "And if you want to deny it, I suggest we step outside."

Fortunately for that guy, the maitre d' intervened at just that moment, imploring me to "settle this peacefully," preferably with a footnote to the sixth chapter. And cooler heads prevailed.

Addendum: If you want to read the actual footnote, with Berube's take on humanistic interpretations of Kuhn, you can find it online here: http://www.michaelberube.com/index.php/weblog/footnotin_frenzy/

His Expert Opinion: Patents and Physics Make Great Partners

By Alaina G. Levine

Editor's Note: *This column is the first of a series that will profile people trained in physics who have gone on to make their mark in a variety of careers. Physics departments have long argued that a major in physics is excellent preparation not only for academia but for many other career opportunities as well. In this series* APS News *will illustrate the versatility of physics with some real-life examples.*

Robert J. Rose has a passion for patents. As Managing Partner of Sheldon Mak Rose & Anderson, a boutique intellectual property (IP) law firm in Pasadena, California, this physics-educated professional has the opportunity to pursue his passion on a daily basis. And the best part of his job is knowing that his physics background gives him the advantage to deliver superior service to his clients.

"Physics is perfect training for law," Rose says. "Law school trains you how to think. You have a jump start on that training when you have learned how to think like a physicist."

Furthermore, "as a physicist, we are always looking at things as a reductionist," he says. "We are always asking of any physical phenomenon: what underlies what we're seeing, what's the cause? This is a very good skill to know as a lawyer."

Of course, he didn't always know he wanted to be an attorney. His heart was set on physics from a young age. "It was the subject in high school I enjoyed most," Rose recalls. "I had the opportunity to work on holograms at a laboratory at the University of Miami and it was like working with magic. I just wanted to continue."

He nurtured his enthusiasm in the desert, enrolling at the University of Arizona in Tucson. When Rose received his Bachelor's of Science in physics and astronomy in 1971, he was certain he was destined for a career as an academic astrophysicist. While in graduate school at the University of Colorado, he witnessed demonstrations against the Vietnam War and realized that his love of and skill in physics could be channeled in a different way.

"I became intrigued by legal issues and the politics surrounding the war," he says. "The draft took some friends and acquaintances, and while I had a high number [in the draft lottery], I think the draft made the war much more personal."

He took the LSAT and did well. He spoke with his advisor and decided to take a year off from graduate school to try law school. The advisor "thought I was crazy and didn't have very nice things to say about lawyers," Rose says.

Returning to the UA for his legal education, Rose instantly found success. "I was good at law school," he says. He recalls how he and other law students who had training in physics and other scientific disciplines excelled in their studies, while those with social science backgrounds struggled with the logical nature of the subject. To this day, Rose stresses "the single most important class you can take as an undergraduate in preparation for law school is symbolic logic," he says. "The more classes you take that require precise logical rigorous thinking, the better you are prepared for law school, and life too."

He easily graduated with high distinction, Order of the Coif, and was an Associate Editor of the Arizona Law Review. After receiving his JD, Rose was selected under the Attorney General's Honors Program to be a Trial Attorney with the Antitrust Division of the US Department of Justice. Later he served as a Special Assistant United States Attorney in the Central District of California, and as Senior Litigation & Antitrust Counsel and Assistant Secretary of Twentieth Century Fox Film Corporation.

Today, he helps clients at the forefront of scientific research. He is involved in a variety of aspects of the IP protection process. He works with clients to evaluate and prepare their patent applications and handles all communications for them with the US Patent and Trademark Office, including any needed appeals. In addition, Rose often does extensive state-of-the-art research. He is often asked to ensure that there is no patent infringement, or to review the

science behind an innovation. He is quick to emphasize his education in physics (as opposed to other scientific disciplines) is especially helpful in this respect.

"Physics training gives you very broad exposure to scientific principles, so no matter what area of science or technology we are dealing with, I have information to draw on," Rose says.

The work of a patent lawyer can also involve litigation, as well as licensing analysis, in which a technology is identified and patented, and the attorney tries to identify potential licensing opportunities for the innovation.

Rose's favorite component of his vocation is preparing expert opinions and working on design around studies, which he joyfully refers to as an "intellectual feast". In providing opinions about the validity of patent claims, from examining the legitimacy of the science to researching who is the rightful owner of the patent, Rose draws upon his physics background. Design around work, he says, is "where you get to really apply a crossover between scientific and legal knowledge so you can come up with ideas for a client that make both practical and technological sense."

Rose cites a recent opinion project in which he was involved. The client was an academic institution. Within the university, one researcher had secured a patent, while another researcher at the same institution claimed he should be credited as a co-inventor. Rose interviewed both individuals, examined their research notebooks, and established the sequence of events that led to the innovation. His opinion was that both could be considered inventors.

Rose says opinion work, aside from the intellectual stimulation involved in analyzing the problem at hand, is rewarding for another reason: the client appreciates it the most. "When preparing a patent, some clients may want the lowest price and not appreciate the value and the time you put into it," says Rose. "But with opinion work they are already worried about something, so when you guide them through the patent thicket they're very happy."

Although he has the chance to scrutinize cutting edge physics research, often before it is made public, Rose does sometimes miss being a researcher himself. "I miss the joy of discovery, the 'aha' moment," he says.

Of course, there are patent professionals who have been able to forge opportunities in which to do research without abandoning IP prosecution. Albert Einstein, for example, was a patent clerk before he became an academic physicist. Some of his most profound and significant papers were produced while he was employed as an examiner in the Swiss Patent Office.

To develop new skills and to partially satiate his appetite for "doing" physics, Rose recently received a M.S. in Imaging Science from the Chester Carlson Center for Imaging Science at the Rochester Institute of Technology. His coursework included ultrasound imaging and magnetic resonance imaging, and his research project was on a method for segmenting nerves in ultrasound images during guided anesthesia.

Today, Rose's expertise lies at the intersection of physics and law, with patent litigation experience in such technologies as intraocular lenses, magnetic resonance imaging, computer graphics and digital image warping, flight simulators, and amusement rides. He is thrilled with his academic and professional decisions, recognizing his physics education has made him a champion in his industry.

"Physics is the premier base discipline upon which to prepare for any professional or scientific career. It is to the 21st Century what philosophy was in prior eras," Rose declares. "It teaches you the value of hard work, and it rewards that work with the keys to science, logic, and life. What more could you want?"

Alaina G. Levine directs the Professional Science Master's in Applied Science and Business at the University of Arizona, and is President and Founder of Quantum Success Solutions. She can be reached through www.alainalevine.com.

Grave Concern About Earth Observing Satellites at Science Committee Hearing

"Flying blind" was but one of the terms that House Science and Technology Committee Chairman Bart Gordon (D-TN) used at a February Congressional hearing to describe the nation's rapidly deteriorating system of Earth observing satellites. Gordon's assessment was shared by committee members on both sides of the aisle during this review of a National Research Council report, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*.

"The United States' extraordinary foundation of global observations is at great risk," the NRC report declared. "Between 2006 and the end of the decade, the number of operating missions will decrease dramatically and the number of operating sensors and instruments on NASA spacecraft, most of which are well past their nominal lifetimes, will decrease by some 40 percent."

One of the major problems highlighted at the hearing was funding. Study co-chair Richard Anthes, president of the University Corporation for Atmospheric Research, testified that "while societal applications have grown ever-more dependent upon our Earth-observing fleet, the NASA Earth science budget has declined some 30% in constant-year dollars since 2000. This disparity between growing societal needs and diminished resources must be corrected." The report's "overarching recommendation" is that the US government, working in concert with the private sector, academe, the public, and its international partners, should renew its investment in Earth observing systems and restore its leadership in Earth science and applications.

Also on hand at the hearing was Anthes' co-chair, Berrien Moore III, director of the Institute for the Study of Earth, Oceans and Space at the University of New Hampshire.Moore told the committee that "at a time of unprecedented need, the nation's Earth observation satellite programs, once the envy of the world, are in disarray." After describing the difficult choices that the NRC committee made in narrowing more than 100 suggested future mission concepts into a far more limited set of recommended missions for the next decade, Moore explained that "the recommended NASA program can be accomplished by restoring the Earth science budget in real terms to the levels of the 1990s."

Moore described NASA's out-year Earth science budgets as fundamentally flawed and "totally inadequate to accomplish the decadal survey's recommendations." The NOAA budget outlook is mixed, Moore said, and assessing it over the long term is difficult because it "is far from transparent."

First conceived in 2004, the report was conducted at the request of the NASA Office of Earth Science, NOAA National Environmental Satellite Data and Information Service, and the USGS Geography Division. The full text can be accessed at http://books.nap.edu/catalog/11820.html.

Courtesy of FYI, the American Institute of Physics Bulletin of Science Policy News (http://aip.org/fyi)

APRIL MEETING continued from page 1

ing a break from its experimental efforts to re-create the conditions of the early universe. During the past year, RHIC has been investigating the origin of the proton's spin, the property that gives the proton its internal magnetism. The origin of this spin remains a mystery. The proton gets only about 25% of its total spin from its quarks (which include not only its three main "valence" quarks but also the quark-antiquark pairs that blink in and out of existence inside the proton's confines). The remaining 75% might come from the proton's gluons, which hold together the quarks and from orbital motions of quarks and gluons in the proton. With help from the RIKEN Institute in Japan, RHIC has been converted part-time into the world's only collider of proton beams with spins that are "polarized" or pointed in desired directions. Nuclear physicists at RHIC are now studying the aftermath of high-energy proton-proton collisions to infer the role of gluons and of orbital quark motion in building the proton spin. RHIC collaborator Steven Vigdor of Indiana University will present preliminary experimental results on these investigations. (W1.3)

Ten Petabytes Per Year More than a decade after physics researchers created the World Wide Web as a way of exchanging data between far-flung research institutions, high-energy physics continues to exert a profound influence on the evolution of the Internet. Now, physicists want to ensure that fast Internet access is available to all collaborators, including those in developing countries. With experiments at the Large Hadron Collider (LHC) expected to produce about 10 petabytes of data each year for more than a decade, a newly developed high-speed "grid" network of 100 computing centers can transmit LHC data at an amazing rate of 10 gigabits per second (an order of magnitude faster than the communication rate between a laptop CPU and its own hard drive) between the dozen fastest centers, and the speed is expected to increase rapidly in future years. Such high-speed networks, in turn, benefit the overall communications infrastructure for research institutions even for projects outside of physics.

However, physicists are concerned that high-energy-physics collaborators in developing nations might not have access to the large bandwidths needed to handle the huge amounts of data from the collider. Presenters in two sessions (M10 and R9) will discuss efforts to reduce this digital divide. Harvey Newman of Caltech will present an introduction to this problem as well as the findings of a major new report exploring this issue. Other talks will present programs to close the digital divide in Latin America (R9.1), South Africa (R9.3), India (M10.3) and Pakistan (R9.4), and the building of a "Virtual Silk Highway" (R9.2) that has brought about fast communications networks to Afghanistan and eight Former Soviet Republics.

Gravity Probe B. Stanford University's Francis Everitt will outline the preliminary results of the $750 million Gravity Probe B mission, possibly the longest-running, most expensive single experiment in history. GP-B is a NASA mission first envisioned in the early 1960s and launched in April 2004. It aims at directly measuring a subtle effect of Einstein's general relativity for the first time. The effect, called frame dragging, is a distortion of space caused by Earth's rotation around its axis, which is expected to deflect the spinning axis of a gyroscope by such a small angle that it would take more than a million years for the gyroscope to turn in a full circle. Following several more months of data analysis, the GP-B team expects to announce its final results by the end of the year.

Northern (Galactic Pole) Exposure. Researchers have combined data from the Arecibo radio antenna in Puerto Rico and the Dominion Radio Astrophysical Observatory interferometer in Canada to produce a stunning view of the sky above the plane of our galaxy. In particular, the image shows a surprising lack of correlation between the faint radiation produced by particles accelerated in the magnetized plasma of space and the distribution of bright stars and galaxies in the nearby universe. The work also offers insights into the origin and nature of some cosmic rays, into how intergalactic ultra-high energy cosmic rays might propagate, and provides a preview of the Galactic and extragalactic features that might contribute to the cosmic microwave background (CMB) on scales to be imaged by the PLANCK CMB Explorer, which NASA and the European Space Agency are jointly planning to launch later this year. Philipp Kronberg (Los Alamos National Laboratory) will present the images resulting from the combined radio data, as well as other insights to come out of the project (H11.4).

New Atomic Effect. Recently, Rudolf Grimm of the University of Innsbruck and his colleagues provided the first experimental demonstration of an atomic phenomenon, first predicted in 1969, known as the Efimov effect. An entire session, B8, will be devoted to this newly observed phenomenon. In the Efimov effect, two atoms which usually repel each other become attracted when a third atom is introduced. The trio can then form an infinite number of "bound states," or energy states in which the atoms are stuck to one another. Atoms entering the Ekimov state veer from their chemical behavior; they behave differently in the company of two other atoms. Grimm will describe his collaboration's experimental demonstration, which involved cesium atoms cooled to ultracold temperatures of just nanokelvins. Also speaking will be the University of Colorado's Chris Greene, who predicted with a coauthor that ultracold atomic gases would be the ticket to observing this elusive effect. Paulo Bedaque of the University of Maryland will describe how the Efimov effect at the scale of the nucleus can provide insights into the theory of nuclear forces.

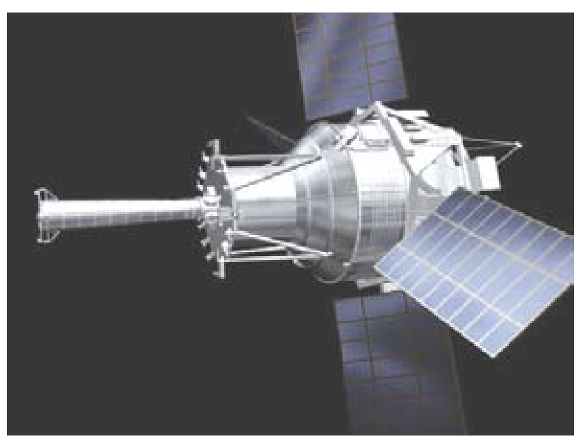

Photo courtesy of NASA

Gravity Probe B satellite in space.

The Life of Pion. In efforts to better understand how the universe evolved into a place with distinct particles and forces, researchers at the U.S. Department of Energy's Jefferson Lab have been performing the Primakoff Experiment (PrimEx). PrimEx is making new precision measurements of the lifetime of a short-lived subatomic object known as the chargeless pion, which can be imagined in simplest terms as a quark-antiquark pair. Before it decays into other particles, the chargeless pion exists for only an attosecond, a thousand times shorter than predicted by early particle theory. Newer theories come closer to this observed result by taking into account chiral symmetry breaking, a phenomenon in which a configuration of nuclear particles and its mirror image do not always behave as mirror images of one another even when researchers perform identical experiments on them.

In PrimEx, researchers aim a photon beam at a nucleus, which perpetually has a cloud of photons around it. Two photons–one from the nucleus and another from the photon beam–interact and make a chargeless pion, which decays into two photons. Measuring the photons provides lifetime information on the pions, with the ultimate goal of obtaining more information on the process of chiral symmetry breaking. Ashot Gasparian of North Carolina A&T State University will present the latest results on PrimEx. (B2.1)

Putting Newton to the Test. Newton's laws break down at some point, giving way to quantum mechanics under some circumstances and relativity at others, and perhaps even yielding to some as yet unknown physical laws somewhere along the way. But just where Newtonian physics crumbles isn't clear. As a result, many researchers have dedicated themselves to tracking down the limits of classical dynamics. Several groups report in session K12 on their efforts to put Newton to the test by searching for unusual gravitational effects at distances below a millimeter; measuring the distance to the moon with millimeter precision via laser ranging; and testing to see if Newton's second law, F=ma, holds when accelerations and forces are extremely small. There's no sign that anyone has succeeded in pinning down the precise limits to Newtonian physics, but all the testing is helping to eliminate exotic theories that attempt to explain away things like dark matter. The experiments are also often the source of new records in precision measurements of fundamental physical laws.

Cosmic Causes of Terrestrial Biodiversity. The diversity of creatures crawling, flying, and swimming across our planet may stem in part from the motion of the solar system through the galactic plane because the radiation that reaches Earth varies as a result of our location in the galaxy. The fact that episodes of large scale extinctions on the planet seem to match the 62 million year cycles of the solar system's motion suggests that evolution may be driven by fluctuations in the radiation that Earth receives. In a series of papers (E11.6, E11.7, and E11.8), University of Kansas researchers Bruce Lieberman, Mikhail Medvedev and Adrian Melott investigate several kinds of astrophysical radiation sources that affect life on Earth, generalizing their earlier computations to improve their insight into the effect of the radiation on the atmosphere. Among other results, they have found that the duration of the radiation exposure makes very little difference. From millisecond gamma ray bursts to 3-year increases in radiation, the ultimate amount of ozone depletion (and the resulting impact on species) is dependent primarily on the total amount of energy dumped in the atmosphere.

Physics Festivals and Fights. People in the general population don't often go in search of science, so some physicists are taking science to the people. Brian Schwartz (Graduate Center of CUNY) will describe the outcomes of some creative science popularization efforts, including a city-wide science festival in New York last November and hands-on physics demonstrations at a New York City street festival in June of 2006 (B5.2). Hugh Haskell (North Carolina School of Science and Mathematics) is interested in a more rough and tumble physics educational effort–he works with the National Young Physicists' Tournament (NYPT), which is modeled on a Russian physics competition started in the 1970s, but is new to the US. Groups of students involved in the tournament tackle a scientific question by developing a theoretical model to address it, performing an experiment to test their theory, and ultimately defending their work while critiquing the research of other groups. The top team in the bare-knuckle physics competition goes on to battle students from 25 other nations in the international stage of the tournament. Haskell and colleagues believe the NYPT ultimately helps build both better physics students and better teachers (C10.1).

A Bit of Physics History. Max Jammer (Bar-Ilan University), a distinguished physicist and author of notable books about fundamental physical properties like mass and space, is the winner of the Abraham Pais Prize Lectureship. Unable to attend the meeting himself, his paper, on the subject of how our modern concept of time came to be (U6.2), will be read out at the session. How the standard model of particle physics came to be so standard will be the subject of Michael Riordan's (UC Santa Cruz) talk in session E10. He contends that the crucial years were 1964-1979, when a series of decisive experiments and incisive theoretical work came together. Other historical talks of interest concern such topics as Albert Einstein's trip to New York City in 1921 (R10.2), the Heisenberg uncertainty principle, early photons in the early universe (E10.5), and a history of arms control prepared by officials at the US State Department (R10.6). Session T6 looks at Sputnik, the 1950s, and the founding of NASA.

LECTURESHIPS continued from page 1

Forums on International Physics (FIP) and Physics and Society (FPS). Jian-Wei Pan of Heidelberg University in Germany spoke on Applications of Quantum Teleportation. Pan was nominated by the Topical Group on Quantum Information, Concepts and Computation (GQI).

A Beller Lecture will be given at the April Meeting by Rudolf Grimm of the University of Innsbruck. Grimm was nominated by the Topical Group on Few-Body Systems and Multiparticle Dynamics (GFB). His talk is titled "Evidence for Efimov quantum states in an ultracold gas of cesium atoms."

The 2007 Marshak Lecture will be given at the April Meeting by Alberto Santoro of Brazil. He will speak on "Closing the Digital Divide in Latin America." Santoro was nominated by the Forum on International Physics.

Until last year, the Beller and Marshak Lectureships had been awarded occasionally. They are now annual events, administered by the Committee on International Scientific Affairs (CISA.) Each year, CISA invites the APS Divisions, Topical Groups, and Forums to submit nominations of candidates for the lectureships.

ANNOUNCEMENTS

M. Hildred Blewett Scholarship for Women Physicists

This scholarship has been established to enable women to return to physics research careers after having had to interrupt those careers for family reasons. The scholarship consists of an award of up to $45,000. The applicant must currently be a legal resident of the US or Canada. She must be currently in Canada or the US and must have an affiliation with a research-active educational institution or national lab. She must have completed work toward a PhD.

Applications are due June 1, 2007. Announcement of the award is expected to be made by August 1, 2007.

Details and online application can be found at http://www.aps.org/educ/cswp/blewett/index.cfm

Contact: Sue Otwell in the APS office at blewett@aps.org

Now Appearing in RMP: Recently Posted Reviews and Colloquia

You will find the following in the online edition of *Reviews of Modern Physics* at **http://rmp.aps.org**

Magnetic microtraps for ultracold atoms

József Fortágh and Claus Zimmermann

Microtraps offer a number of important advantages over conventional magnetic traps for confining degenerate atomic quantum gases. The tight confinement causes a higher vibrational splitting between modes and the miniature design makes it practical to integrate additional tools into the structure. .

This article describes the principles of microtrap design and the experimental considerations of microtrap construction.

Call for Nominations

2008 APS Excellence in Education Award
Deadline: July 1, 2007

The award, which consists of $5000 and a certificate citing the achievements of the recipients, was established to recognize and honor a team or group of individuals (such as a collaboration), or exceptionally a single individual, who has exhibited a sustained commitment to excellence in physics education.

Five copies of the nomination packet should be submitted to the chair of the selection committee, Ken Krane, at the following address:

Department of Physics
Weniger Hall 301
Oregon State University
Corvallis, OR 97331-6507

Electronic submissions will not be accepted. The deadline for nominations for the second award is July 1, 2007. Further information may be obtained on the APS web site at http://www.aps.org/programs/honors/awards/education.cfm or by contacting the chair of the selection committee at kranek@physics.oregonstate.edu.

EMPLOYMENT continued from page 3

The proportion accepting postdocs generally rises when potentially permanent positions are scarce and falls when conditions improve. Physics PhDs usually have a low unemployment rate, even in difficult economic times, the report says.

Foreign citizens, who make up about half of new PhD recipients, are more likely than US citizens to take postdocs, the survey found. New PhDs in more applied subfields are more likely to accept potentially permanent positions.

Most of those who accepted postdocs are working in physics or astronomy, most often in a field closely related to the area in which they received their degree, while only about one-quarter of those in potentially permanent positions are working in physics or astronomy.

Engineering is the largest field of employment for physics PhDs in potentially permanent positions. Others are working in a variety of areas, including business, finance, and computer software and hardware. About half of those in potentially permanent positions said physics was an appropriate background for their job.

DONATION continued from page 1

Advanced Placement program enables high-school students to take college level material and often to gain college credit for their work]. The other is UTeach, a program at the University of Texas at Austin that has become a national model for science teacher preparation. The UTeach program has doubled the number of UT Austin students receiving math and science teacher certification.

The University of Texas at Austin is a member of the Physics Teacher Education Coalition (PTEC), an association of physics departments dedicated to the improvement of K-12 physics and physical science teacher preparation. PTEC grew out of the APS-led PhysTEC program for improving teacher preparation. (see PhysTEC story on page 1).

"Programs like UTeach and those offered at other PTEC institutions are demonstrating that universities can produce significant numbers of high school physics teachers, but there must be a commitment by the institution toward this effort. We have seen dramatic increases in the number of high school physics teachers educated at a number of institutions like UT Austin (the home of UTeach) where significant changes to the program have been implemented." said Ted Hodapp, APS Director of Education.

UTeach now graduates over 70 new math and science teachers each year. Over 80 percent of UTeach graduates are still teaching four years later, compared with only about 60 percent nationally.

Several elements have made the UTeach program successful. UTeach actively recruits students by sending letters to every student in the College of Natural Science. To make the program affordable, UTeach gives students access to scholarships and paid internships, and the first two introductory courses are free. UTeach employs eight full-time "master teachers," former secondary school teachers who now teach the teacher preparation courses and organize field experiences. From the first semester of the program, UTeach students engage in field experiences, teaching supervised lessons in public schools.

One factor in the program's success is the significant collaboration among the College of Natural Science, the College of Education, and teachers from local schools, said Michael Marder, a professor of physics and co-director of UTeach. "The most important element in UTeach is the fact that groups of people who used to work separately have come together," said Marder, who is also the chair of the APS Committee on Education.

UTeach has implemented the practices that PhysTEC and PTEC promote to improve science teacher preparation. "What is special about UTeach is that we've taken a lot of good ideas and found ways to put them into practice," said Marder.

Physics majors at the University of Texas at Austin can enroll in the Physics Teaching Option, in which they earn an undergraduate degree in physics and a Texas secondary teaching certification. UTeach now graduates a few physics majors per year. Students who major in other subjects can receive certification to teach physics, said Marder, but "I really feel that a physics major is the strongest person to teach physics."

Scientists and Engineers Get the Oscar for Improving Film Production and Preservation

Each year, the Academy of Motion Picture Arts and Sciences awards its Scientific and Technical Achievement awards to the scientists and engineers that have designed and developed technologies that contribute to the progress of the film industry. These technical innovations have been successfully used in movies and have become the gold standard by which new technologies are judged.

This year's 15 awards include praise for film production and preservation. The awards were presented on Saturday February 10, 2007. Here is a sampling of some of this year's winners.

FILM PRODUCTION

ILM Image-Based Model System. Steve Sullivan, the Director of Research and Development at Industrial Light and Magic (ILM), worked with a team of electrical and computer engineers to design and develop the ILM Image-based Model System.

This system starts with one or more images of an object or scene, such as a landscape, prop, or humane face. Then, a combination of computer algorithms and artist tools are applied to create a 3D model. "The resulting model is often comparable to a laser scan of the object," said Sullivan. "The system can help visual effects artists create detailed models directly from a few photographs, even for subjects such as babies or large-scale landscapes which are impossible to scan using traditional techniques."

The software behind the making of this creepy face (right) from Pirates of the Caribbean won an Oscar this year.

OpenEXR Software System. Florian Kainz, the computer graphics principal engineer with the Research and Development group at ILM, designed and engineered the Open EXR software system. OpenEXR is a set of software libraries and a file format for storing digital images with very high fidelity, which is required for creating visual effects in movies as well as scientific visualizations. One feature of this system is the ability to store more than just the color information with each pixel. "For example, in computer graphics, when you want to simulate motion blur that results from photographic moving objects," said Kainz, "You need to know how fast and in which direction the objects in an image are meant to move."

Image courtesy of Industrial Light and Magic (LM)

"Wyvern" in Pirates of the Caribbean: Dead Man's Chest

FI+Z. Howard Preston, President of Preston Cinema, using his experimental and theoretical physics background, has designed the Preston Cinema Systems FI+Z wireless remote system. Up until the early 1990s, wireless devices used to remotely control camera and lenses were unpredictable on a movie set because they interfered with the many communication devices such as high-powered walkie-talkies commonly found on movie sets.

FILM PRESERVATION AND ARCHIVING

E-Film. Bill Feightner, the Executive Vice President and Chief Technology Officer at E-Film, designed and developed the E-Film process. When preserving film, the colors of the film would break down over time. This made trying to keep a film perfectly intact very difficult. With E-Film, each negative is separated digitally into 4 different negatives: one that is in black and white, yellow, cyan (blue), and magenta (red).

Using E-Film, these digital negatives and additional information about the colored digital negatives could be recombined at a later date to produce the same vibrant colors they had during the very first time the movie played.

Rosetta Process. Phil Feiner, Jim Houston, Denis Leconte, and Chris Bushman of Pacific Title and Art Studio designed and developed the Rosetta process to create film master positives, which is an exact color copy of the film for archiving from the original digital master files. This process is unique because the digital YCM (yellow, cyan, and magenta) positives are created directly from the film and not from a digital version.

The black-and-white separations from this process have a potential shelf life of more than 1,500 years when properly stored.

Courtesy of Inside Science News Service

The Back Page

The Human Dimension is Key to Controlling Proliferation of WMD

By Elizabeth Turpen

If a rogue state or terrorist organization needed insider support to acquire weapons-grade fissile materials or additional expertise to design a nuclear device, where should it send its headhunter? The most probable place to find applicable scientific talent for hire would be the former Soviet Union. Described as a potential "Wal-Mart for terrorists" by one expert and "the greatest unmet threat to U.S. security" by a bipartisan U.S. Government commission in 2001, the legacies of the cold war arms race–nuclear, chemical and biological –continue to provide plenty of sleepless nights for those of us focused on the sheer magnitude of unsecured materials and underemployed experts that could be used to perpetrate catastrophic terrorism. Equally disturbing is the consistent political rhetoric regarding the number one threat to U.S. security being at the "crossroads of technology and international terrorism" without the corresponding political will to effectively address the most plausible source. In addition, the proclivity to favor high-tech fixes over addressing the enduring human dimension of the problem remains an outstanding liability for U.S. programs.

When the Soviet Union collapsed in 1991, roughly 20,000 weapons and stockpiles of highly-enriched uranium and plutonium for an additional 40,000 weapons, as well as an estimated 40,000 tons of chemical weapons and a robust biological capability, were spread over what would rapidly evolve into 15 sovereign states spanning eleven time zones. Moreover, tens of thousands of scientists, engineers and technicians that comprised the backbone of the Soviets' unconventional weapons programs went from relative riches as an elite corps of patriots to highly skilled excess capacity residing in bloated weapons complexes throughout the region. In response to the rapidly evolving crisis, Congress passed the Cooperative Threat Reduction (CTR) Act. Colloquially known as Nunn-Lugar after its authors former Senator Sam Nunn (D-GA) and Senator Richard Lugar (R-IN), CTR provided Defense Department funding and expertise to: 1) consolidate and secure weapons of mass destruction in safe areas; 2) inventory and account for these weapons; 3) provide safe handling and safe disposition of these weapons as called for by arms control agreements; and 4) offer assistance in finding gainful employment for thousands of former Soviet scientists with expert knowledge of weapons of mass destruction or their delivery systems.

The early momentum created by this effort laid the foundation for a broad array of programs spawned by other U.S. agencies, especially the Energy and State Departments, and, in some cases, pursued multilaterally by U.S. allies. In 1996, legislative action in the form of the so-called Nunn-Lugar-Domenici bill explicitly recognized the terrorist threat and expanded and enhanced threat reduction activities. At the 2002 Kananaskis Summit, other members of the G-8 committed themselves to match the United States' commitment to CTR totaling $10 billion over ten years, an agreement initially dubbed "10 plus 10 over 10." More recently, Congress authorized CTR activities to extend beyond the territory of the former Soviet Union (FSU). In over a dozen years of evolution and roughly $12 billion in U.S. security investments, these efforts can lay claim to the following achievements: deactivation of over 6,900 warheads, including the entire arsenals from the former Soviet republics of Belarus, Kazakhstan, and Ukraine; destruction of more than 2,300 delivery systems; elimination of over 290 metric tons of highly enriched uranium; enhancements to security in transport and storage as well as accountability for both weapons and weapons materials; and engagement of approximately 71,000 scientists in civilian research.

While the full roster of accomplishments is impressive, particularly in light of the lack of focused political commitment and relatively minuscule proportion of U.S. security investments to achieve progress, it remains wholly inadequate. The U.S. Government has been whittling away at the risks emanating from the cold war legacy for fifteen years, and depending on what aspect of the threat one is talking about and what metric for progress one applies, we are still only about half way there. Why the slow pace to address the most obvious source of proliferation? Certainly sufficient blame might be laid at the feet of fickle host governments, particularly in Russia. But a significant proportion of fault remains with the United States. The maverick, innovative approaches in the early years of threat reduction that yielded rapid progress have long since given way to turf battles between agencies, insufficient high-level attention to lay the foundation for more intensive and expeditious cooperation, and congressional and bureaucratic propensities for muddling through, despite the continued risk of loose materials and unemployed weaponeers.

In-depth research regarding lessons learned and possibilities to improve these nonproliferation efforts gives rise to the following conclusions: First, "Cooperative Threat Reduction" is more than a group of programs to address supply-side concerns in the proliferation equation. If applied appropriately, Cooperative Threat Reduction can also address the demand-side aspects of the equation. This is evidenced by the decisions on the part of Ukraine, Kazakhstan and Belarus to forego nuclear weapons state status–respectively the third, fifth and eighth largest nuclear weapons states upon independence–as a result of focused U.S. diplomatic efforts and promises of assistance. Second, without White House attention to getting the job done, these endeavors can fall prey to pernicious bureaucratic behavior and a dysfunctional interagency process. Third, and most importantly, whereas weapons can be dismantled and materials controlled, the people cannot. Instead of approaching the human dimension as a threat to be contained, it should be incorporated as part of the strategy to address the demand-side of the equation. In this vein, U.S. industry and academe should be brought along as partners to achieve sustainable rollback of WMD capabilities. Each of these lessons is part of a comprehensive approach that should be applied to future iterations of threat reduction efforts, whether those opportunities arise with respect to North Korea, Iran or other states with the scientific capabilities to achieve nuclear status.

Despite global public opinion polls regarding declining U.S. popularity, America's scientific and business acumen is respected and coveted worldwide. This tool in our foreign policy approach to reversing the proliferation tide is not being used effectively. Never mind that oftentimes industry is leagues ahead of federally-funded research and development efforts, especially in the most innovative or ethically complicated aspects of "high-tech," and yet is regarded as an outsider or peripheral to government policies in the day-to-day discussions inside the DC Beltway. The U.S. Government has yet to grasp the key point–and this is relevant to the cold war legacy as well as to combating terrorism more generally–"it's about the people, stupid." Economic opportunity has a key role to play in potentially reversing "rogue" states' proliferation calculations and offering opportunities to those thus far marginalized by globalization.

With respect to the enduring threat of WMD proliferation from the FSU, however, this lesson remains vital. We have consistently downgraded efforts to provide stable commercial opportunities to the scientific capacity–due to the long-term nature of such efforts and the fuzzy metrics which must be applied with respect to "conversion" of human capacity–in favor of the more easily quantifiable aspects of dismantling weapons and securing materials, despite the obvious issue that any progress made would be readily reversible without sustainable, civilian employment. In addition, with few exceptions, these efforts have only in retrospect tried to address the need for stable employment, not to mention the opportunity to address U.S. foreign policy objectives of economic development, integration into the global economy, and rule of law. Had we thought about the human dimension of proliferation as an opportunity rather than a risk and offered industry sufficient incentives to participate in creating sustainable commercial job opportunities in these fledging democracies, we would be measurably farther along in advancing our nonproliferation and many other vital national interests.

What has happened by accident in a handful of cases illustrates what is feasible by design. A high tech company based in Albuquerque, New Mexico works with a group of highly skilled specialists at the General Physics Institute in Moscow for different aspects of design and improvements to the company's nuclear safeguards equipment. This same safeguards equipment is utilized by the Department of Energy's Materials Protection, Control and Accounting (MPC&A) program to contain and account for weapons-grade materials in the FSU. Collaboration between a California biotech company and a team of former biological weapons scientists has yielded a new vaccine for treatment of Hepatitis C, an increasing public health threat in Russia and globally. In an early iteration of programs, the Defense Department contracted a New York company to convert a factory producing nuclear-tipped torpedoes in Kazakhstan to civilian production. This $3 million investment resulted in a cryogenic vessel production facility to service the rapidly growing oil and gas industry in the region. In addition to providing sustainable employment to the lion's share of workers at the former torpedo factory, this facility later became the primary supplier of equipment for the cylinders requisite to DOE's efforts to secure plutonium bearing fuel assemblies in Kazakhstan upon closure of a breeder reactor. Moreover, this case provides a concrete example of the "secondary" benefits of such efforts with respect to achieving other foreign policy objectives in the course of addressing the possible risk of know-how proliferation. Beyond sustainable employment and providing products needed by a Department of Energy nonproliferation program, the transfer of business management skills, training in quality assurance and quality control, and the positive economic impact on the region, this factory's management became a vociferous agitator for the rule of law in an otherwise hostile business environment.

In the Stimson Center's survey of the U.S. Government programs geared toward addressing the know-how proliferation threat, two shining examples not left to serendipity do exist. First, the Defense Department's Biological Threat Reduction Program has teamed with the Centers for Disease Control to leverage the scientific capacity of former biological weapons scientists in Central Asia and the South Caucasus to build a network for infectious disease surveillance across the region. Second, modeled after a program created in the mid 1990s to promote economic diversification among the DoE laboratory complex, the Law Enforcement Targeted Initiative (LETI) is a partnership to promote development of civilian law enforcement technologies by former Soviet WMD institutes. Under this arrangement, law enforcement agencies, in Russia and beyond, are the customers of Russian institutes R&D services.

A train is bearing down on the threat reduction activities funded by the United States. Policymakers at the agencies and many members of Congress are looking for an "exit strategy" from threat reduction engagement in the region. This is particularly true as Russia flaunts its petrodollar wealth, and the escalating costs for the war in Iraq begin to squeeze all other aspects of our national security budget. Unfortunately, an exit strategy that does not ensure an indigenous capacity to sustain the measures that the U.S. has so painstakingly put into place may render fifteen years and the expenditure of billions of dollars moot. More frighteningly, a premature exit greatly increases the risk of WMD terrorism through the seepage of materials or know-how to any well-endowed source willing to bid.

As Sam Nunn repeatedly puts it: "We're in a race between cooperation and catastrophe, and the threats are outrunning our response." Our response to the most likely source of materials or know-how that could contribute to catastrophic terrorism has been dangerously inadequate. Addressing the human dimension of the threat is not only the lynchpin to sustainability of these efforts, but represents underexploited potential to achieve a whole host of U.S. foreign policy interests. Moreover, an opportunity exists to address public health, energy, environmental and nonproliferation needs through more efficient leveraging of the scientific and technical talent in the region of the former Soviet Union. Through innovative engagement of U.S. industry and academe as partners in achieving U.S. policy goals, not only can we better address proliferation challenges but also provide attractive incentives to induce a different calculation by states flirting with the WMD option and reduce the risks of know-how proliferation to the highest bidder.

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APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org