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Task Force Blasts Teacher Preparation Efforts
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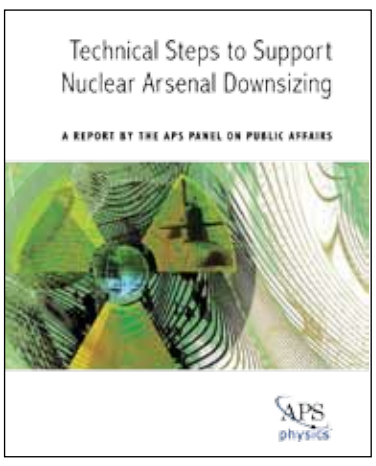
Report Presents Strategies for Nuclear Arsenal Downsizing

Preventing the spread of nuclear weapons while reducing and securing the country's nuclear stockpile is achievable but likely to take time, according to a new APS report. The study, titled "Technical Steps to Support Nuclear Downsizing," was conducted by the Panel on Public Affairs to organize steps the United States could take to reduce nuclear threats worldwide.

The report was, in part, prompted by the upcoming Non-Proliferation Treaty Review Conference. Every five years, signatories to the nuclear nonproliferation treaty meet to discuss ways to work toward the treaty's goals of reducing nuclear weapons around the world. In addition, President Obama has stated that nuclear weapons reduction is a goal of his administration and is negotiating with the Russians to set up a new bilateral weapons agreement to replace the Strategic Arms Reduction Treaty, which expired in December 2009.

"I think the administration intends investment and action on all those grounds, and what we've done is said 'here's a way to do this,'" said Jay Davis, a lead study participant and founder of the Defense Threat Reduction Agency and former U.N. weapons inspector in Iraq. Davis, who is president of the Hertz Foundation, added that he hopes that it also prompts more in-depth study by individuals with access to classified information, after officials in the administration get a chance to examine the report's conclusions.

Davis says that although there are no major technical obstacles to the reduction of nuclear weapons, diplomatic and political issues, as well as secrecy concerns, are the biggest impediments to the global reduction of nuclear weapons.



"One of the dangers is always to project your own beliefs and perceptions onto other countries," Davis said, adding that it was important to incorporate "the attitudes of countries that don't currently have nuclear weapons but might want them" into any non-proliferation framework.

The report breaks down the overall aim of nuclear weapons reduction into three main goals: verifying the dismantling of nuclear weapons, maintaining the country's capability and expertise, and ensuring the peaceful use of fissile materials. The study establishes

DOWNSIZING continued on page 7

Visa Problem Keeps Iranian Physicist from Attending March Meeting

By Michael Lucibella

Visa complications prevented a renowned Iranian physicist from attending this year's March Meeting in an apparent case of mistaken identity. Though these kinds of identity mix-ups are rare, long visa processing times are normal for physicists traveling to the United States.

Farhad Ardalan, a string theorist at Sharif University of Technology in Iran who helped establish its first doctoral program, was denied a travel visa by the United States consulate in Switzerland in January. Though the error was ultimately corrected and his visa was cleared six days before the meeting, the logistics to get the embassy to stamp his passport in time made it unfeasible for him to attend.

The first sign of trouble came when he applied for his J-1 visa at the US embassy in Bern where he was asked if he had ever been arrested. He responded that he never had been, "Not even in Iran." He was then told that he had a US arrest record from 1983, despite the fact that he was in Iran for all of that year and at that time the Iranian government banned travel to the United States. He was told he would not be allowed in the United States and was asked to relinquish his green card. Ardalan refused to turn it over and left the consulate.

In a follow-up communication he had with the embassy, he was told that State Department found a record of deportation proceedings against him in 1962; however he has no recollection of any visa problems while he was an undergraduate at Columbia.

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Panel Prepares to Weigh APS Members' Input on Climate Change Commentary

Late in February, APS members received an email message from President Curtis Callan, soliciting their input on the issue of climate change. Members were asked for input on a proposed commentary to be added to the APS climate change statement, which was originally passed by Council in November of 2007. As *APS News* goes to press, the comment period is still open, and a subcommittee of the Panel on Public Affairs (POPA) are getting ready to analyze member input once the March 19 deadline has passed.

The series of events leading to this situation began at the Council meeting last May, when a motion was introduced by Councilor Robert Austin to substantially change the 2007 statement. The motion was tabled, and then-President Cherry Murray appointed an ad hoc committee, chaired by Daniel Kleppner, to advise her. The Kleppner committee recommended sending the statement to POPA to address issues of "clarity and tone." In response to this charge, an ad hoc subcommittee of POPA, chaired by Duncan Moore, produced a commentary of several paragraphs on the statement. That commentary has now gone to the full APS membership for their input.

In order to submit a comment, an APS member must click on the URL provided in the email. The link is unique to the individual member, and insures that he or she can submit a comment

PANEL continued on page 7

Closing In on Dark Matter and High-Energy Cosmic Rays

The vacuum of outer space is not quite as empty as one might believe. Exotic particles fly through the interstellar void, continually bombarding Earth from all directions. Physicists at the "April" Meeting presented the latest discoveries made here on Earth about these astronomical sojourners.

Cosmic Rays

High energy protons careen through the cosmos as so-called cosmic rays. Though first identified early in the 20th century, their origins have largely remained a mystery. Now, Stefan Funk from the Kavli Institute for Particle Astrophysics and Cosmology thinks he might have discovered their source. Using data from NASA's Fermi Gamma-ray Space Telescope, he has been able to pinpoint supernovas as the likely cause of this interstellar radiation.

The term "cosmic ray" is a misnomer, as the radiation detected on Earth is from high energy protons traveling though space, not electromagnetic radiation. Because these "rays" are in fact charged particles, interstellar magnetic fields deflect them, making it difficult to pin down their origins. Funk says that the key to finding their source lies in cosmic gamma rays.

The force from exploding supernovas accelerates protons to velocities near the speed of light. When these high-energy protons collide with interstellar gases, they create short-lived pions that then decay into gamma rays. Funk says that the sources of cosmic rays would thus produce large amounts of gamma rays. As the paths gamma rays travel are unaffected by magnetic fields, the sources of cosmic rays can be inferred by looking for signature gamma ray emitters in space. Using the Fermi Telescope, the team found such strong gamma rays emanating from supernova remnants, including Cassiopeia A, W51C and W44.

"Shock waves of these giant stellar explosions in our galaxy are cosmic accelerators way

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Prize and Award Recipients at APS "April" Meeting

Photo by James Tkatch

At the "April" Meeting in February, APS President Curtis Callan presented certificates to many of the 2010 APS Prize and Award recipients. The recipients (including one from the American Institute of Physics) posed with President Callan after the ceremonial session. Seated (l to r): Moishe Pripstein, Gustav-Adolf Voss (AIP), Ronald K. Thornton, Priscilla Laws, Calem R. Hoffman, Stephen G. Brush, Claus Rolfs. Standing (l to r): Gerald S. Guralnik, Abdul Nayyar, T. W. B. Kibble, Joseph Birman, Carl R. Hagen, Herman Winick, Herman B. White, David Sokoloff, Eugene W. Beier, John Peoples, Jr., Curtis G. Callan, Tingjun Yang, Steven C. Pieper, Robert B. Wiringa, Frans Pretorius, Robert Brout, Pervez Hoodbhoy, François Englert.

Members in the Media

"Physicists tend to be super critical of strong conclusions, but the data on global warming now indicate the conclusions are not nearly strong enough."

***Leon Lederman**, Fermilab,* The Christian Science Monitor, *March 11, 2010.*

"The surprise was that we couldn't find unpredictable people…We are all boring."

***Albert-László Barabási**, Northeastern University, describing his work studying the patterns of people's movements using their cell phone logs,* AOL News, *February 18, 2010.*

"Arbitrarily closing the case on a Friday afternoon should not mean the end of this investigation,"

***Rush Holt**, House of Representatives, on the FBI ending its investigation of the 2001 anthrax attacks,* The New York Times, *February 19, 2010.*

"I think Hollywood's attitude will be, if we can make it more realistic without spoiling the story and without it costing too much more money, we will do it, but there are always those restraints,"

***Sidney Perkowitz**, Emory University, on trying to get more accurate science in Hollywood Movies,* CNN.com, *February 22, 2010.*

"There's nothing better today,"

***Kip Thorne**, Caltech, on videos from the 1950s he still uses to teach students fluid dynamics,* The Atlantic, *February 23, 2010.*

"I was hiking up at Lake Tahoe in California and noticing the shapes of trees, and wondering, 'Why do they have a given shape over another?"

***Jeffrey Grossman**, MIT, describing the inspiration for his new folded design for solar cells,* MSNBC.com, *February 25, 2010.*

"By the time you get to 10 years, I've always felt it's time to move on, do something else, do something fresh…The university's in great shape, the board of trustees are very stable, the finances are in pretty good shape."

***Jack Wilson**, University of Massachusetts, on stepping down from the presidency of the university,* WBUR.org, *March 1, 2010.*

"It would be better if DOE just took this back."

***Arjun Makhijani**, Institute for Energy and Environmental Research, on drums of depleted uranium waste slated to be transferred from South Carolina to Utah,* The Salt Lake Tribune, *March 3, 2010.*

"Wherever there is a battle over evolution now there is a secondary battle to diminish other hot-button issues like Big Bang and, increasingly, climate change. It is all about casting doubt on the veracity of science–to say it is just one view of the world, just another story, no better or more valid than fundamentalism."

***Lawrence Krauss**, Arizona State University,* The New York Times, *March 4, 2010.*

"By accelerating the gold (gold was selected because it is very heavy) at extremely high speeds, we were able to replicate the conditions right after the big bang… At a temperature of about 2 trillion degrees, which is about 100,000 times hotter than the surface of the sun, we were able to produce a new form of matter."

***Carl Gagliardi,** Texas A&M,* UPI, *March 4, 2010.*

"Deuterium is in sea water. The oceans of the world contain sixty billion year's worth of deuterium. Tritium comes from lithium, lithium salts are in sea water."

***Steven Cowley**, Culham Centre For Fusion Energy,* BBCNews.com, *March 5, 2010.*

"I saw a marvelous BBC production of 'Copenhagen,' with really great actors who clearly didn't understand physics…I doubt it was noticeable to anyone but a physicist, but there were one or two places where I said, 'Ouch!'"

***David Gross**, University of California Santa Barbara, on portraying physicist Werner Heisenberg in a UCSB production of the play,* Los Angeles Times, *March 5, 2010.*

"I'm used to standing in front of an audience but I'm telling my

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This Month in Physics History

April 12, 1912: Victor Hess's balloon flight during total eclipse to measure cosmic rays

Today we take it for granted that Earth's atmosphere is constantly bombarded by high-energy cosmic rays originating far outside our solar system. But such was not always the case. It was a 29-year-old Austrian physicist named Victor Hess who officially "discovered" cosmic rays, and went on to devote an illustrious scientific career to studying the effects of radiation on the human body.

Born in Austria in June 1883, Hess was the son of the chief forester for the estate of Prince Oettingen-Wallerstein. He attended the University of Graz in 1901 and earned his PhD at 23. Hess initially planned to study optics under famed physicist Paul Drude, the man who gave physics the symbol *c* for the speed of light. Tragically, Drude committed suicide weeks before Hess was due to arrive.

Victor Hess getting ready to measure cosmic rays, Austria, 1912.

The young Victor wound up accepting a position at the University of Vienna instead, studying under Franz Exner, an early pioneer in the study of radiation. Under Exner's tutelage, Hess began studying radioactivity and atmospheric electricity. It was during his work as an assistant at the Institute for Radium Research at the Austrian Academy of Sciences that Hess became intrigued by frequent reports of electrical charges being detected inside electroscopes–no matter how well those containers were insulated. Most scientists at the time believed the source of the ionization to be terrestrial in nature–radioactivity from ground minerals–and postulated that the ionization measured in the atmosphere therefore would decrease the further one got from the ground.

Prior experiments with electroscopes gave rough estimates of ionization levels in the atmosphere, but those results seemed to indicate that the levels might actually increase beyond a certain altitude. For instance, in 1910, Theodore Wulf measured ionization at both the bottom and top of the Eiffel Tower in Paris, and found that there was far more ionization at 300 feet (the top) than one would expect if this effect were solely attributable to ground radiation. Other scientists mounted their instruments on balloons to record ionization at higher levels, but their results were inconclusive due to instrumentation defects.

Speculating that perhaps the main source of the ionization could be in the sky rather than the ground, Hess tackled the problem first by designing instruments that could withstand the temperature and pressure changes at higher altitudes. He also determined that ground radiation would no longer produce ionization at 500 meters.

Hess then mounted his instrumentation on a balloon and made ten separate ascents over the course of three years (1911-1913), measuring ionization levels. He found that initially ionization fell off with height, and then began to rise rapidly. At a height of several miles, the ionization was several times greater than that at Earth's surface. Hess concluded that "a radiation of very high penetrating power enters our atmosphere from above."

Another clinching piece of evidence came during Hess's ascent on April 12, 1912, during a near-total eclipse of the sun. Since the ionization did not decrease during the eclipse, Hess concluded that the source of the radiation could not be the sun itself; it had to be coming from further out in space. Hess's findings were confirmed in 1925 by Robert Millikan, who dubbed the mysterious radiation "cosmic rays." Hess shared the 1936 Nobel Prize in Physics for this discovery, along with Carl D. Anderson, who discovered the positron.

There is an interesting twist to Hess's Nobel story. In February 2010, Italian physicist Alessandro de Angelis of the University of Udine published a paper on the arXiv, claiming that Hess should not be solely credited with the discovery of cosmic rays. De Angelis pointed out that another scientist, Domenico Pacini, made the same discovery right around the same time. Pacini didn't use a balloon to measure changing radiation levels in the atmosphere. Instead, he went underwater, placing his instrument in a copper box and sinking it in the Bay of Livorno. His results: the radiation measured was significantly less than at the surface, so the Earth's crust could not be the source of cosmic rays.

De Angelis offered the very first English translation of Pacini's paper on this experiment, and pointed out that Hess and Pacini knew of each other's work. So why do we remember Hess, and not Pacini? Chalk it up to an unfortunate twist of fate. Pacini passed away in 1934 and the Nobel Prize cannot be awarded posthumously. So Hess alone was honored for cosmic rays.

Two years after Hess received the Nobel Prize, the Nazis invaded Austria and Hess was abruptly dismissed from his post as professor of physics at the University of Graz, in part because his wife was Jewish, and in part because he had been a scientific representative in the independent government of Chancellor Kurt von Schuschnigg. Warned by a sympathetic Gestapo officer that he and his wife would be sent to a concentration camp if they stayed in Austria, the couple fled to Switzerland.

Hess immigrated to the US to become a professor at Fordham University. He participated in the first tests for radioactive fallout less than a year after the atomic bomb was dropped on Hiroshima, many conducted from the 87th floor of the Empire State Building in New York City. The following year found Hess in the bowels of Manhattan, mea-

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Education Corner

A column on educational programs and publications

New Faculty Workshop

APS, the American Association of Physics Teachers (AAPT), and the American Astronomical Society will sponsor the seventeenth Workshop for New Faculty in Physics and Astronomy from June 28-July 1, 2010, at the American Center for Physics in College Park, Maryland. More than 1,200 newly hired physics and astronomy faculty have participated in this series of workshops since the initial offering in 1996. The discussion format and small breakout groups of the Workshop permit the participants to exchange ideas with one another and with leading innovators in physics and astronomy education.

For more information see www.aapt.org/Events/newfaculty.cfm. New faculty should be nominated online by their Department Chair at www.aapt.org/conferences/secure/newfaculty_nomination.cfm as soon as possible and no later than April 15.

LaserFest Kits Available

As part of LaserFest, APS has developed a laser-based unit for high school physics classes. APS will provide kits to teachers wishing to teach this unit. The kits include a lesson plan that guides students through an exploration of the properties of laser light, an online laser simulation created by the PhET project, and a few applications of lasers. The kits were developed with National Science Foundation and Department of Energy funding. If you provide professional development for high school physics teachers and would like to order laser kits, please write to Ed Lee at lee@aps.org.

APS will also run a High School Physics Teachers Day at the Division of Atomic, Molecular and Optical Physics (DAMOP) meeting for the first time this May in Houston. The program will include hands-on workshops on diffraction and laser light, and a video on the LIGO gravitational wave detector.

ALPhA to Offer "Laboratory Immersions"

During the summer of 2010, the Advanced Lab Physics Association (ALPhA) will be inaugurating their "Laboratory Immersions." Last year's APS/AAPT-sponsored Topical Conference on Advanced Laboratories highlighted the need for training opportunities which would broaden the expertise of advanced laboratory instructors. ALPhA's Laboratory Immersions offer an opportunity to spend three full days, with expert colleagues on hand, learning the details of a single experiment well enough to teach it with confidence. The 2010 Immersions are: June 1718, Dickinson College, PA; July 17, Reed College, OR; Aug. 2–4, Buffalo State College, NY; Aug. 11–13, Caltech, CA. For details, including topics and registration, please visit www.advlab.org.

National Lab Day

The Obama administration has initiated efforts by science and mathematics societies to encourage members to reach out to K-12 teachers and their students. One result of this is called "National Lab Day," which has a website to help connect science professionals with teachers who are looking to work with local scientists to expose students to real-world applications, to excite them to think about careers, and to bring needed resources to their classrooms. Visit www.nationallabday.org to view projects in your area or nationally where you can contribute.

An Activity-Based Physics Chautauqua Short Course

Priscilla Laws, David Sokoloff, Ronald Thornton, and Maxine Willis are offering a 3 day Chautauqua Workshop at Dickinson College in Carlisle, PA from June 19-21, 2010. This hands-on course is designed for those interested in creating an active learning environment in their introductory physics courses using research-based curricula and tools. Participants will be introduced to strategies they can adapt for each component of their intro course: lecture, lab, problem solving, analytic mathematical modeling and video analysis. Graduate credit is available. For more information and to register, visit http://uoregon.edu/~sokoloff/chaut1.htm

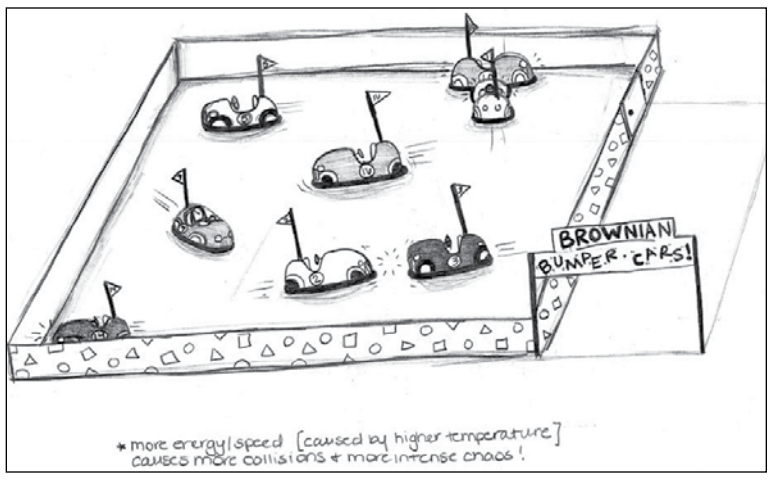
Federal Funding for STEM Education

The Obama Administration's 2011 budget requests include increases for STEM education, a major priority of the President. At the Department of Education, the Administration proposed to reorganize and rename the Math Science Partnership (MSP) program to become Effective Teaching and Learning: STEM (which stands for Science, Technology, Engineering, and Mathematics). Funding would increase 66% to $300M, and support professional development for STEM teachers, implementation of high-quality curricula, and creation of systems for linking student data with instructional supports.

At the National Science Foundation, education programs within Education and Human Resources (EHR) directorate were requested to increase 2.2% to $892M. The 2.2% increase for EHR is considerably lower than proposed increases to the rest of the NSF, where the research directorates received increases of 8.2% to just over $6 billion. Big winners in EHR include Graduate Research Fellowships, which the administration is trying to triple in number by 2013, and funding for the Human Resources Development Division (up 7.6% to $103M).

Art Enhances Physics Learning

By Calla Cofield



A good metaphor can go a long way, especially when it comes to explaining science. But of course, all metaphors eventually fall apart.

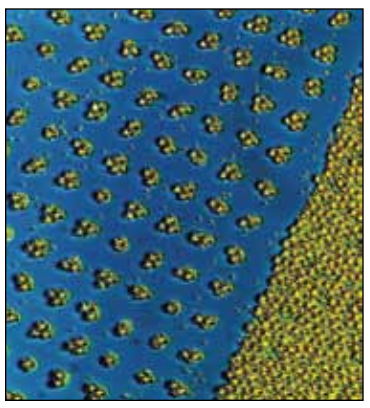
Rather than view this as a disadvantage, Felice Frankel sees it as an opportunity. Frankel is a science photographer and holds concurrent positions at the Wyss Institute and Systems Biology at Harvard Medical School and at MIT. She is currently the principal investigator for a program called "Picturing to Learn," which asks undergraduate students of physics, chemistry and biology to draw or illustrate the concepts they are learning as if they were explaining the science to a high school student. This often requires the use of a metaphor or the simplification of the concept. What Frankel says is most helpful about the illustrations is not seeing the students illustrate the concepts correctly, but finding the concepts they miss or get wrong. This allows professors to pinpoint the concepts the students have missed, and prepare their lectures accordingly.

"You can talk about what the student has drawn and what the metaphor is, but you can also talk about where the metaphor falls apart," says Frankel. "And I think that also leads to a much deeper discussion about the concepts and a deeper understanding."

So far, Frankel and the Picturing to Learn program have collected over 4,000 student drawings showing things like bumper cars to illustrate Brownian motion. The program is funded by the National Science Foundation, and the student drawings will be made available online sometime in March.

Physics students aren't the only ones Frankel thinks could use visual communication lesson. She also leads Image and Meaning workshops, which offer scientists, writers and communicators consultation and training in creating better, more meaningful images to accompany their publications.

Frankel discussed in her talk at the APS April Meeting in Washington DC that these workshops can help scientists when they are writing articles or books for the public, as well as journal articles or papers for their peers. Separate rules apply to each instance; Frankel says she would never edit anything out of a photograph for a journal, but she might do so in a book for the general public if it made the subject of the photograph more visible or for a journal cover design. However, scientists can still find ways to improve the photographs and other figures they use for journal publications. Frankel uses the example of two photographs she took of self-organizing colloids that arrange themselves in neat rows. The first photo shows the colloids alone, while a second photo show them next to non-self organizing colloids (the image appears in *Advanced Materials*, Volume 14 Issue 8, Pages 545-548). Members of the audience nodded and voiced agreement that the second image sent the message much better than the first.



Self-organized colloids

"We know how powerful visualizations are," Frankel said at the April Meeting. "The public swallows them up! But we also know how wrong they can be."

Frankel is aware that, as she states in reference to the Picturing to Learn program, metaphors fall apart. An illustration of a scientific concept, or a color corrected photo can leave a false or incomplete impression on the audience, so while Frankel strongly encourages scientists to include more images with their work, she also emphasizes the need to educate the public on how those images are created and what they mean. She says the fact that she explains how she generated her images, and any treatment she's done to them, is what distinguishes her from a traditional artist or photographer.

Despite the challenge presented by translating science through imagery, Frankel says the feedback from the scientific community has been positive, and scientists realize that a good image can be worth a thousand words.

More information can be found at www.picturingtolearn.org and www.imageandmeaning.org. Felice C. Frankel is coauthor with George M. Whiteside for *No Small Matter, Science on the Nanoscale* (Harvard University Press, 2009).

New Experiments to Probe the Intensity Frontier

By Calla Cofield

In 2009, high energy particle physics grabbed the world's attention as the Large Hadron Collider smashed through the previous record for energetic particle collisions, and the next few years hold promise for great new discoveries. While it may not be grabbing headlines, the intensity frontier is heating up as well, with the start up of T2K in Japan, construction underway for the NOvA project, and plans for Project X gaining momentum.

From the J-PARC facility in Tokai, to the Super Kamiokande detector in Kamioka, the T2K (Tokai to Kamioka) experiment sends a beam of neutrinos 295 kilometers east to west across Japan. The T2K detectors are now part of the 50,000 tons of water and 11,200 photomultiplier tubes that make up the Super-K water Cherenkov detector. Super-K is used primarily to study neutrino oscillations, although this type of detector was originally intended to search for proton decay. Eventually, physicists hope that studying neutrino oscillations will reveal the mechanisms behind the universal matter-antimatter asymmetry. If equal amounts of matter and antimatter were created after the big bang, they should have annihilated each other; and yet, we see that enough matter survived to form stars, planets and people. T2K began operations in early 2009 and in February 2010 announced that its detectors observed their first neutrino event at Super-K.

In the US, another long baseline neutrino experiment, the Main Injector Neutrino Oscillation Search, MINOS, continues to run strong as construction began last year on it successor, NOvA (NuMI Off axis ν_e Appearance). NOvA will occupy a new facility not far from the Soudan Mine and the site of MINOS. The new facility will continue to utilize Fermilab's NUMI neutrino beam, but will extend the baseline distance to 810 kilometers. MINOS currently uses a steel-scintillated detector consisting of planes of magnetized steel and plastic scintillators, while NOvA will use a 15,000 ton liquid scintillator.

Early plans and discussions are on the table for an even longer neutrino experiment that would send the Fermilab beam over 1300 kilometers to the Deep Underground Science and Engineering Lab, DUSEL, in South Dakota. That project–tentatively called the Long Baseline Neutrino Experiment–could be greatly enhanced if Fermilab gets the green light for a proposed high-intensity proton accelerator complex, currently called Project X.

Project X would build on Fermilab's current accelerator infrastructure, and provide beam for a variety of physics projects, including an increase in the intensity of the beam to NOvA, and experiments to explore rare decays of

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Letters

Entrepreneurial Centers Can Help to Resurrect US Industry

The pitiful state of US industrial research has been addressed by Philip Wyatt in the December 2009 *APS News*. This was followed by substantial response in the February 2010 Issue by Ginzburg, Ouellet, Mendis and Myers. But a realistic practical path to resurrection and sustained maintenance is lacking.

Most successful industries have been founded by technical/scientific/idea people. But control of these companies has eventually evolved to "managerial" and "money" people with minimal relevant industrial knowledge and deficient innovative skills. The result is that these companies have "crashed" with limited lifetimes of ~50-100 years. To generate and sustain companies with much longer lifetimes, new strategies are needed.

Industrial companies should have internal "Entrepreneurial Centers" to continuously generate and sustain profitable new growth. They would be deliberately separate, but partially fueled by innovations from their companion Industrial Research Centers. Individuals would establish new companies, under the corporate umbrella and with some initial corporate investment.

Those innovative individuals must also invest their own personal money, assets and time, because personal commitment is the key to probable success. In addition to initial investment, the parent company would provide support in appropriate ways such as facilities, equipment, etc. These new operations would eventually evolve into separate free-standing operations, probably with additional external investment, and finally self-supporting sales income.

The attempt to insert innovative ideas into existing corporate divisions has failed miserably, because these divisions have the same inflexible attitude as the parent company. Thus the need for Entrepreneurial Centers in addition to Research Centers. The view that we only need more research is not realistic.

Chuck Gallo
Lake Elmo, MN

Climate Change, Obesity and the Need for Modesty

The doctor has the patient's medical history, including weight and heart data (blood pressure and electrocardiogram), showing an undesirable trend. If the doctor is careful, the heart data have to be somewhat discounted because they are taken only in office visits, with unknown distortion from daily life.

The physicist has the earth's CO_2 and climate history, with similar or worse need for caution. The one thing the doctor knows for sure is that the patient's current weight is higher than in past years. The one thing the physicist knows for certain is that atmospheric CO_2 is higher now than in the last 100 years. The doctor thinks, but cannot prove, that the heart is showing worrisome symptoms, which will improve with loss of weight. The physicist thinks, but cannot prove, that global temperatures have risen and that the trend will be reduced by lowering CO_2 emissions.

Why does the doctor tell the patient to lose weight? There are excellent statistical correlations between obesity and life-shortening diseases. But the patient knows the difference between statistical correlations and prediction of a particular case. There is no proof that the patient's particular case of obesity will adversely affect the patient's life span, or, even if it does, there is no proof that the quality of life remaining will be adversely affected. Similar objections apply if we tell the world's population to reduce CO_2 emissions.

The doctor's confidence in statistical correlations is much improved by theory. Current medical science offers plausible scientific reasons why obesity harms health. Current physical science offers plausible reasons why anthropogenic CO_2 increases global temperature.

There are imperfections in this analogy. They tend to favor the doctor and disfavor the physicist. For a start, the patient is paying the doctor for advice. This can motivate belief. The doctor's heart data, although imperfect, are harder to disqualify than data on mean global temperature. In the end, the doctor's job is important, and no one expects the doctor to be fully scientific. The doctor has a responsibility to speak forcefully even if strict scientific standards are impossible to meet. What about the physicist? The analogy suggests two things. (1) It is important to acknowledge that physical science cannot provide perfect guidelines, and that scientists will seek a consensus about likely truth and still disagree with each other about the details. Just as people should ask their doctor (rather than their pastor, mayor, or astrologer) for advice about health, so they should ask physical scientists for advice about the earth's climate. They should not expect greater certainty from physical science than from medical science. (2) When speaking forcefully, it should be done with at least as much modesty as we expect from our doctor, because we have at least as much reason for modesty.

Philip B. Allen
Stony Brook, NY

APS Could Use Division of Global Climate

Since 1966, APS has become a federation of Divisions. There is no Division that has scientific jurisdiction over global climate, and therefore APS Council has no jurisdiction either. APS should have a clearly stated policy with respect to the scope of its statements on issues of public policy. Such a statement should acknowledge that physics is a scientific discipline with limited scope, and not a source of special knowledge on every topic of public concern. If it aspires to enjoy public respect, it must recognize the importance of restraint on matters beyond its ken. At this time, global climate is a case in point.

However, if and when the Council decides to create a Division on Global Climate, it would then, in due course, have a body of expertise on which to base responsible policy statements.

Lawrence Cranberg
Austin, TX

RAYS continued from page 1

beyond LHC energies." Funk said, "We can't distinguish [the source] just from the gamma ray detection; we have to look at other data. But if you put all the pieces together it seems that we are looking at gamma rays from accelerated protons."

Dark Matter

Gravitational observations of distant galaxies show that there is a tremendous amount of mass in the universe unaccounted for. Analysis has shown that this dark matter, so called because it doesn't emit any detectable electromagnetic radiation, is five times as abundant as ordinary matter.

Dark matter is theorized to consist of Weakly Interacting Massive Particles, or WIMPs. Despite their abounding numbers, they have proven to be among the most difficult of all the exotic particles zipping through the cosmos to isolate. However, physicists think they are getting close.

The Cryogenic Dark Matter Search, with detectors located deep in an old iron mine in Soudan Minnesota, is set up to detect some of the subtle interactions these WIMPs have with normal matter. Similar to neutrinos, the theorized WIMPs can pass through a tremendous amount of ordinary matter without interacting with any of it. However, once in a while a WIMP will impact the nucleus of an atom, sending it recoiling into other atoms. Sensitive detectors made of crystal germanium the size of a hockey puck, buried deep in the mine are looking for signs of this subtle reaction.

Image from CDMSII photo archive

Closeup of a ZIP detector in its mount. A detector of this kind, made of Si, was operated in the 1998 run. The photolithographically-fabricated thin film on the surface is the phonon sensor and represents a significant advance over the detectors used in the 1999 run. Silicon and germanium ZIPs, weighing 100 g and 250 g respectively, will be used in future CDMS II runs at Stanford and in the Soudan mine.

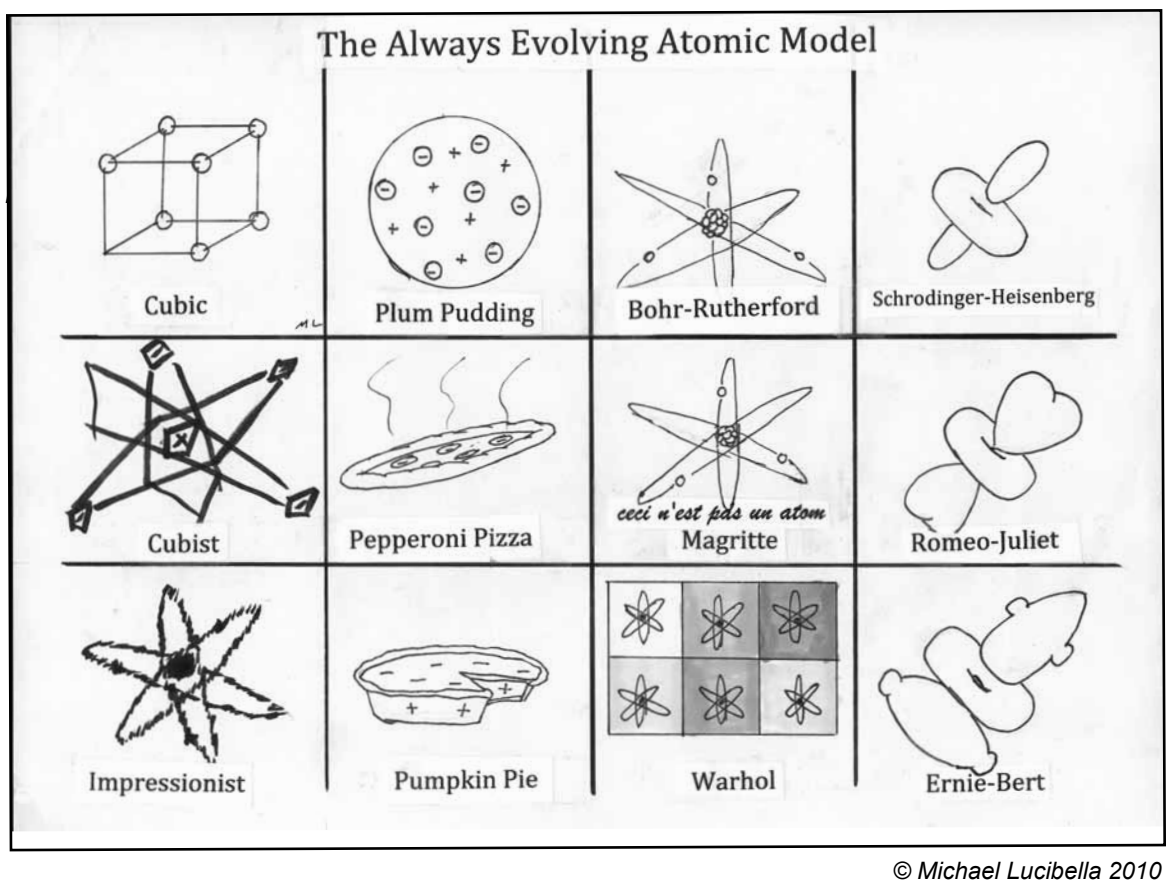
"Every once in a while there's an interaction," said Angela Reisetter from the University of Minnesota and a member of the dark matter search, "From a single nucleus recoiling, all this stuff happens which can be measured throughout the detector."

In early February, the group announced that the detector had registered two anomalous signals. These readings were inconclusive as to whether the culprit was an elusive WIMP or merely background.

"It's simply a maybe," Reisetter said at the "April" Meeting, "At two events, you just can't say. You can't call it background, but you can't call it a signal."

She said also that the search was continuing. The team was in the process of installing more sensitive detectors in the mine. After they're in place and calibrated, the search will run for about a year starting in the fall, with new results expected at the end of 2011 or early 2012.

By Michael Lucibella



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Math Literacy is a Vehicle for Civil Rights

By Calla Cofield

Deep in the rural farmland of Mississippi, in the heat of the African American Civil Rights Movement, driving a bus could be a dangerous thing. Robert P. Moses knew this as he got behind the wheel of a vehicle carrying African American sharecroppers from their rural homes to the nearest voting stations. The long drives were often interrupted by encounters with people who opposed civil equality. More than once those encounters turned violent. At one point Moses faced legal persecution for his efforts, though his actions were protected by the U.S. Constitution. Despite the difficult journey and the many obstacles that he faced, Moses continued, literally and figuratively, to drive the bus.

In the 1960's Moses served as field director of the Student Nonviolent Coordinating Committee (SNCC) and later the co-director of the Council of Federated Organizations (COFO), an umbrella organization for major civil rights groups in the south. Through his efforts Moses became recognized as one of the most influential and important leaders of the civil rights movement. Over the past fifty years he has continued with his work toward racial equality, but he has shifted his focus to education, and it is through those efforts that he is gaining the attention of the scientific community.

Moses grew up in New York City in a small housing development project. He earned a scholarship to Hamilton College, and attended Harvard where he received an M.A. in philosophy in 1957. He settled into teaching math at a nearby high school, but was called home for family matters. Upon returning to New York, Moses became involved in the civil rights movement that was heating up across the nation. He reached his own boiling point in 1960 and traveled to Atlanta to fight the tide of civil inequality.

Of all the obstacles that Moses faced as he worked for African American civil rights, none seemed as great or as powerful as illiteracy. In some states, illiteracy could directly stop African Americans from voting due to literacy tests that voters were required to pass before casting their ballot (although, many literate African Americans were also told that they had failed the test). But Moses recognized that education did more than allow citizens to vote. It gave them freedom to rise above their economic class, and to participate in the national and political discussions that would change their lives.

Over the next twenty years, national literacy rates continued to rise, and yet underprivileged and impoverished minority groups remained chained to the economic and social situations they were born into. Watching his own children grow up in the developing information age, Moses recognized that the ability to read was no longer enough to change the course of these people's lives. Mathematical literacy was now the key.

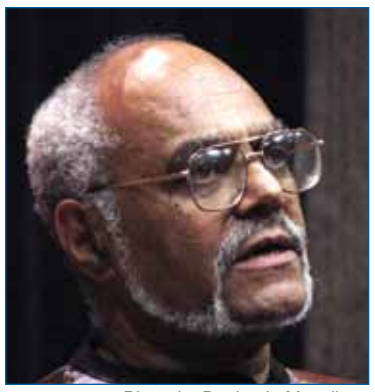

Photo by Benjamin Moynihan

Robert P. Moses

"I had experienced what it meant for the sharecroppers in the delta not to be able to read and write. They were serfs in our industrial age," said Moses in an interview. "That is the equivalent, in this information and technology age, of mathematical literacy."

In 1982 Moses became a MacArthur Foundation Fellow, and used the Fellowship to start The Algebra Project. The program builds algebra curriculum that is specific to the location and the lives of the students learning it.

"I could not have done this if I'd majored in math," said Moses in an interview at the 2010 APS April Meeting. "Majoring in philosophy and under someone who was both a math logician and a philosopher of math put me in touch with ideas which I was able to use when I got into looking at the actual learning of algebra."

One of those ideas is changing the questions that students ask when they try to solve problems. When learning the number line, as opposed to asking "how many?" students are taught to ask "which way?" Algebra Project students from Brooklyn, New York, took a trip across the Brooklyn Bridge and took pictures of their journey (teachers from these schools say many of the students had never crossed the bridge). Those pictures are then arranged on a number line, and students learn how to navigate along the line based on those familiar locations. The method teaches important core concepts like adding and subtracting negative numbers.

The program goes beyond simply teaching the math concepts to convincing the students that their education is the key to reaching their goals. One part of the project is to have teachers from the students' own neighborhoods, and to then encourage the students to go into teaching careers there as well. The Algebra Project holds that when students see teachers who come from their same geographic, racial, and economic background, this does more to convince them of what careers they have within their reach, than when teachers come from outside the student's own area.

"We started with the lessons that we learned in getting the sharecroppers to demand their rights," said Moses in his talk at the APS April Meeting. "How do we get students to demand their education? The Algebra Project is working from the demand side of this. We're not talking about teachers and their practices. We're talking about students and their culture."

The Algebra Project was in over 200 schools by the late 1990's and is now in ten states. Students from the Project's earlier years are now old enough to come back and teach or assist with teaching a new generation. In an interview after his talk Moses said that this will finally allow the Algebra Project to begin evaluating the long-term impact the program is having on students.

Moses is currently serving as a Frank H. T. Rhodes Class of 1956 Visiting Professor at Cornell University. He has received honorary doctorate degrees from more than ten institutions including Harvard University and Princeton University. He continues to speak about current civil rights issues. He delivered a talk at the 2010 April Meeting of the American Physical Society on the issue of whether or not the US is ready to discuss making quality education a constitutional right. While he is taking action to spark discussion on this topic, he says the real battle will not be his to fight. Rather, that will be for the next generation of civil rights activists–the next group of people to drive the bus.

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muons and kaons. Project X Fermilab Associate Director for Accelerators Stephen Holmes spoke on the status of Project X at a press conference at the APS "April" Meeting in Washington DC.

"Project X is currently in a R&D phase. We have a fairly advanced concept for the facility that is forming the basis for the R&D program," said Holmes in an email. "This concept would provide capabilities beyond what anyone else in the world has today and/or is planning for the future… What needs to happen next is the formal recognition of the need for this facility to support the DOE mission." That formal support would come in the form of a Critical Decision 0, which Holmes says he hopes the project will achieve in the next year.

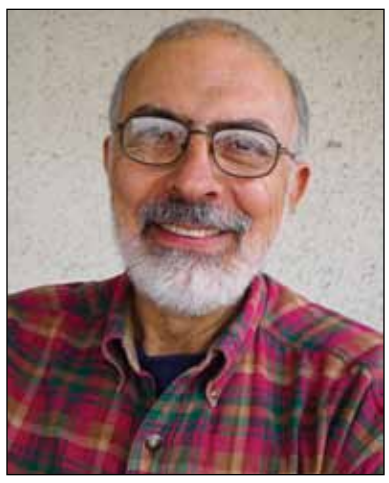
The investment in the intensity frontier is not only for the study of rare decays and neutrinos, although those studies present the potential for major advances in physics. In addition, high intensity instruments will prove crucial in confirming and understanding new phenomena uncovered at high energy experiments, like those at the LHC.

"The things that we learn in the energy frontier have to be consistent with the things that we learn in the intensity frontier," said Duke University physicist and T2K collaboration member Chris Walter, who also spoke at the press conference. Walter explained in an interview that many theories that scientists at the LHC hope to test, such as Super Symmetry, can be confirmed through rare processes that occur at lower energies, but only with very intense sources.

"This will be our first step using these new high intensity accelerators," said Walter. "We hope to make some exciting discoveries and then continue on towards our future ultimate goals."

VISA continued from page 1

Ardalan has traveled to the United States many times before without incident. He entered Columbia University in 1958 and earned a PhD from Penn State in 1970. He taught at Sharif University for several years but spent his sabbaticals at Yale and Stony Brook in 1974 and 1977 respectively. In 1993 he and his wife received green cards to stay in the US where he resided until her death in 2003. He said he never encountered any problems from the United States.



Farhad Ardalan

He had planned to attend a reception held at the March Meeting for recently elected Fellows sponsored by the Forum on International Physics. There are no US embassies in Iran, so while he was visiting CERN in January he traveled to the US embassy in Bern to acquire his visa.

"I think it's a case of mistaken identity," said John Clark, a physicist at Washington University who was a sponsor of Ardalan's visit to the US. He said that there is an individual in Iran with the same name who is the leader of a Kurdish guerilla movement. This has caused Ardalan travel delays from the Iranian government before, but never prevented him from traveling abroad.

The Department of State did not respond to submitted questions before press time.

Clark contacted Norman Neureiter, the director for the Center for Science Technology and Security Policy at AAAS, who in turn brought the matter to David T. Donahue, Deputy Assistant Secretary for Visa Services in the State Department. Working together they were able to sort out the confusion with the consulate over Ardalan's visa by March 9th. However because of the logistics of physically getting his passport stamped, Ardalan was unable to rebook the needed flights to Bern and the United States in time for the March Meeting. Instead he plans to come to the United States sometime in April.

"As to what the State Department should do in these cases, it is not really for me to say," said Ardalan, "However, my advice, for whatever it is worth, to our government agencies is to rely more on the judgment of the respective scientific organizations, when it comes to security issues related to the scientists."

Though what happened to Ardalan is unusual, setbacks and delays at US embassies around the world have become more common in recent years. Over the last decade security concerns have dramatically increased the wait times for scientists to receive visas. Identity mix-ups are uncommon, but slow processing times are not.

"His case was something beyond just a simple delay," said Amy Flatten, APS director of international affairs, "His visa delay was unusual."

Over the last decade, national security concerns by the federal government have caused major holdups for nearly all types of visa applications. Especially affected are applications that go through a visa mantis check, which aims to identify individuals that could illegally transfer sensitive technology. Most requests from scientists visiting the United States automatically go through this check, adding to their visa's processing time.

As of March 2009, it took on average sixty days for a visa to be processed with a visa mantis check, the last time concrete numbers were available on the program. Last June, a request from 30 of the country's leading organizations of US higher education, science, and engineering, prompted the State Department to incorporate new procedures to streamline the process. Though no official figures are available, it does seem that wait times are now on the decline.

Security safeguards imposed after the attacks of September 11th initially caused wait times to extend to an average of seven months. Efforts by the State Department brought the average waits down to about 14 days in 2005, but increasing backlogs caused wait times to lengthen once again starting in late 2007.

There is also a high degree of inconsistency that comes with these wait times. Some applicants, like Ardalan, encounter long unexpected delays, while others are processed quickly. The nation of origin plays some role in visa delays, as people from countries about which the State Department has security concerns are often subject to closer scrutiny. However the wait times that come with this additional scrutiny are also irregular, and it is difficult to predict precisely how long a wait time will be.

"The most important thing is to apply early," said Flatten, adding that the APS website has information for physicists applying for visas, what to do if there is a delay, and links to the State Department's consular office with up-to-date average wait times.

Flatten said also that she and the APS have been working with the State Department and other agencies to help streamline the visa process for visiting scientists. She and others from the scientific community met with the Assistant Secretary of State for Consular Affairs Janice L. Jacobs about the issue.

"Creating a system that balances scientific mobility and national security has been the goal, but has encountered the obvious challenges," Flatten said, "I believe the State Department is trying to work with the science community to improve that."

Teacher Preparation Conference Focuses on Diversity

By Gabriel Popkin

The sixth annual Physics Teacher Education Coalition (PTEC) Conference took place in Washington, DC in mid-February, just prior to the APS "April" Meeting. The conference is the largest gathering in the country dedicated to physics teacher preparation, and for the fourth straight year attracted over 100 participants, many of whom battled record-breaking snow storms and travel difficulties to get to the event.

The theme of this year's conference was "Diversity in Physics Education: Preparing Teachers for the 21st Century." In two panel discussions on Friday that focused on issues in urban and minority-serving schools, participants got a chance to hear the perspectives of young teachers in urban classrooms as well as faculty members at urban institutions. Another workshop led by Duane Merrell of Brigham Young University tackled the very different challenges of rural physics education.

Other conference sessions focused on the persistent achievement gap between richer and poorer students, as well as between underserved minority students and the rest of the US population. A panel of faculty and teachers discussed the preparation not just of teachers but of teacher leaders who will address such inequalities by becoming change agents in the educational system. Michael Marder, a physics professor at the University of Texas in Austin, presented data on the achievement gap in Texas, a state that often sets national standards in education. A group of graduate and undergraduate students from the UC Berkeley, discussed the Compass Project, which aims to increase diversity in the physical sciences.

The conference also featured a number of highly visible national efforts in science and mathematics teacher preparation. Marder, who co-directs the University of Texas's UTeach Program, led a workshop on the UTeach replication effort, which supports thirteen universities to develop programs modeled after the one at Texas. Following that, Joseph Heppert of the University of Kansas led a workshop on UKanTeach, the UTeach replication effort at his university.

Photo by Ken Cole

Joel Corbo and Angie Little of the University of California, Berkeley's Compass Project share a morning conversation at the PTEC Conference.

Another highlight of the conference was a workshop on the "Chemistry Teacher Education Coalition," which is a PTEC-inspired effort by the American Chemical Society to engage chemistry departments in teacher education. As in years past, the Association of Public and Land-grant Universities also had a strong presence. The group organized a reception for conference attendees whose institutions are members of the Science and Mathematics Teacher Imperative, a group of public research universities that have committed to increasing the number of science and math teachers they prepare.

Many attendees stated that they appreciated the networking opportunities with other members of the teacher preparation community. "It's great to be around a group of people who care about the same things I do," said Vera Margoniner of California State University, Sacramento, who was attending her third PTEC Conference.

"The fact that 80 percent of those who registered showed up in spite of the extreme weather is a testament to the dedication of the PTEC community. Many of our presenters and attendees had flights canceled several times, and still managed to get to the conference," said Monica Plisch, the Assistant Director of Education at APS and the conference's lead organizer.

PTEC is a coalition of 180 universities, colleges, and national labs. It is part of the PhysTEC project, which is run by APS and the American Association of Physics Teachers, with National Science Foundation support. More information is available at www.PTEC.org.

Task Force Calls Physics Teacher Preparation Massively Inadequate

By Gabriel Popkin

The national Task Force on Teacher Education in Physics released a set of findings and recommendations on February 13 at the 2010 Physics Teacher Education Coalition (PTEC) Conference. The release, which summarizes more than two years of research on physics teacher preparation programs at American universities, is the synopsis of a report the task force plans to publish later this year.

The task force was jointly sponsored by the APS, the American Association of Physics Teachers, and the American Institute of Physics, and is composed of physics and education faculty, university administrators, and high school teachers who have been closely involved in national physics education efforts. Its charge was to survey the US physics teacher preparation scene, identify best practices for increasing the number of qualified physics teachers, and establish research, funding, and policy priorities for improving the situation.

The task force's chief finding was that "Except for a handful of isolated pockets of excellence, the national system of preparing physics teachers is largely inefficient, mostly incoherent, and massively unprepared to deal with the current and future needs of the nation's students." The authors identified a number of areas in which they felt improvement was needed, including collaboration between physics and education departments, physics-specific pedagogical preparation of teachers, induction and mentoring support for new physics teachers, and professional development for physics teachers coming from other disciplines.

The authors also drew a connection between the state of US physics teacher education and the country's challenges in the science and engineering labor market, stating that "An effective precollege physics education is indispensable in preparing U.S. students for global competition." To address these challenges, the authors wrote that "Physics departments, schools of education, university administrators, school systems, state agencies, the federal government, as well as business and foundations, have indispensable collaborative roles to play so that *every high school student has the opportunity to learn physics with a qualified teacher.*"

Stamatis Vokos, professor of physics at Seattle Pacific University and the task force's chair, said that while the situation is grim, there is potential for improvement. "We hope that our report will serve as a wake-up call for universities, foundations, and government agencies around the country. The problem is very serious, and any significant progress will require a focused and coordinated effort from all corners."

The task force plans to distribute its full report to every physics department and education school in the country. More information about the task force as well as a copy of the synopsis is available at www.ptec.org/taskforce .

MEMBERS continued from page 2

story and it's my physics. It's quite different getting inside of someone else."

Alan Heeger, *University of California Santa Barbara, on portraying physicist Niels Bohr in a UCSB production of "Copenhagen,"* Los Angeles Times*, March 5, 2010.*

"We enter this process with no preconceived conclusions,"

Robbert Dijkgraaf*, Universiteit van Amsterdam, after being named chair of a review board for the U.N. Intergovernmental Panel on Climate Change reports,* The Associated Press*, March 10, 2010.*

"There is some advantage to encouraging people to think about the energy that a car or a home or a power plant involves…Whether it's called the Rosenfeld or not doesn't matter to me. I would never call it that myself–that's immodest."

Arthur Rosenfeld*, California Energy Commission, on a unit of power savings being named after him,* San Jose Mercury News*, March 11, 2010.*

If It's Broken, Fix It

by Michael S. Lubell, APS Director of Public Affairs

Dys·func·tional [dis-ˊfəŋ(k)-shə-nəl]–adjective : (1) relating badly; (2) not performing as expected; (3) affected by disease or impairment. Three definitions: take your pick. Each one of them suits today's United States Senate.

It is not what the founding fathers had in mind when they struck the "Connecticut Compromise" at the 1787 Constitutional Convention, establishing the Senate as an upper chamber with equal representation from each state and six-year terms, so that its members could act as a check on the dangers of unbridled democracy the founders expected from the nascent "people's" House of Representatives.

They wanted senators to be insulated from public opinion and feel empowered to take the long view. They wanted senators–who weren't even directly elected until passage of the Seventeenth Amendment in 1913–to act as a brake on pell-mell legislative gambits House members might pursue to achieve electoral success every two years. They wanted the Senate to be a speed bump. They never envisioned it would become a roadblock.

The 1787 Convention also rejected the British system of parliamentary government in which the majority party's leader is the prime minister. Instead, led by James Madison, the Convention adopted a presidential system with an independent executive and a system of checks and balances. Their decision served our nation well for more than two centuries. But it is in danger of lapsing into irrelevance.

President Obama ran on a platform of bipartisanship and change, which is fine if both political parties buy into the concepts and if governing structures can facilitate the goals. It's a prescription for failure when members of Congress dig in their ideological heels and focus on posturing for the next two-year election cycle rather than achieving substantive legislative results. It's a prescription for failure when the Senate cannot act unless 60 percent of its members agree it should.

Blame Obama for overreach-

FIX IT continued on page 7

HESS continued from page 2

suring the radioactivity of granite in the 190th Street subway station near Fort Tryon.

Along with William T. McNiff, Hess developed "an integrating gamma ray method" for detecting minute traces of radium in the human body, thereby making it possible to determine if someone was suffering from radium poisoning before it became critical.

Even after retiring from Fordham, Hess continued to do research. He was keenly interested in creating a more accurate scale of how much radioactivity the human body could tolerate–a difficult thing to determine, since individuals could tolerate different levels, and because the effects were often cumulative, taking as along as 50 years to fully present. He strongly opposed nuclear testing, claiming, "We know too little about radioactivity at this time to state definitely that testing underground or above the atmosphere will have no effect on the human body."

Hess died on December 17, 1964, but his legacy lives on. In 2004, an observatory opened in the deserts of Namibia to detect gamma rays from cosmic sources. It was named the High Energy Stereoscopic System (HESS) telescope, in homage to the man who discovered cosmic rays.

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 4, 2010. Announcement of the award is expected to be made by August 2, 2010.

Details and on-line application can be found at http://www.aps.org/programs/women/scholarships/blewett/index.cfm

Contact: blewett@aps.org

PTEC Topical Workshop:

Pedagogical Content Knowledge

Rutgers University, New Brunswick, NJ

April 19–20, 2010

Rutgers University, in cooperation with the Physics Teacher Education Coalition (PTEC), invites you to attend a workshop that will change how you think about preparing physics teachers. This two-day topical workshop will highlight the unique Pedagogical Content Knowledge (PCK)-based curriculum developed at Rutgers.

For more information, please see www.ptec.org/conferences/PCK2010

Reviews of Modern Physics:

Recently Posted Reviews and Colloquia

Searches for supersymmetry at high-energy colliders

Jonathan L. Feng, Jean-François Grivaz and Jane Nachtman

Particle physics is at a crossroads. In the past three decades the standard model (SM) has been successful in describing all known elementary particles and their interactions. Ahead of us is the CERN Large Hadron Collider offering great possibilities to search for and study new phenomena, in the mass range from 100 GeV to several TeV. This article reviews the current state of experimental searches for supersymmetry, the most widely studied extension of the SM. Beyond the Higgs boson that has yet to be discovered, there are strong motivations for supersymmetry, including the need to explain dark matter and the desire for unification of all fundamental forces.

http://rmp.aps.org

DOWNSIZING continued from page 1

steps for the US to take to accomplish each goal.

It recommends that the United States declassify the number of nuclear weapons in its arsenal, establish sites to test verification technologies, and fund the development of "nuclear archeology" to examine a suspected site's past nuclear use. So far, the report has been well received, with the Department of Energy setting up a center near the old Nevada testing sites to research possible verification technologies.

The report also emphasizes the importance of preserving the country's capability and expertise while decreasing the number of weapons. Those that remain need to be maintained properly, so that in the unlikely event they are needed, they function correctly. Additionally, the US should refurbish its nuclear infrastructure and refocus the National Nuclear Security Administration so it can more efficiently maintain a scaled-back arsenal, the report says.

"The good news is we can do it. The bad news is it will take a long time. But, if Congress follows the report's recommendations, downsizing the nuclear arsenal can be done safely and securely," said Davis, announcing the report at the annual meeting of the American Association for the Advancement of Science.

To make sure that nuclear fissile materials are used peacefully, the report recommends that the government invest in programs to detect secret nuclear facilities, share information among nuclear industries, and prioritize non-proliferation at the Nuclear Regulatory Commission.

PANEL continued from page 1

only once. The member input will be reviewed and analyzed by the POPA subcommittee. It will not be publicly available.

At press time, 5723 members had viewed the proposed addendum, and 1690 comments had been submitted. Once the Moore subcommittee has reviewed them all, it will, if necessary, revise the commentary, and bring the revised version to POPA for consideration. It is intended that all this will be accomplished in time to submit a final version to the APS Executive Board and Council, which meet on April 17 and 18. The Board and Council will either accept POPA's recommended commentary, return it to POPA for further consideration, or possibly reject it outright. The Board and Council will not, however, indulge in further wordsmithing of the document that POPA produces.

The procedure that is being adopted marks the first time that the opinions of the full membership have been systematically solicited with regard to an APS statement. If the process is successful, it may serve as a model, going forward, for how APS statements are to be crafted, modified, and passed.

Results of POPA's deliberations and of Council's actions will be reported in the next issue of *APS News*.

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ing if you want. Blame him for promoting too much big government if that's your judgment. Blame him for lack of engagement and leadership if you see it that way. But don't blame him for what has become a de facto parliamentary system in which political parties refuse to collaborate for fear of electoral retribution from their staunchly ideological bases. Don't blame him for a Congress in which the House of Representatives looks more like the House of Commons and the Senate, the House of Lords, each with a governing party and a loyal opposition.

At least in the British system, new elections are held when a government loses a parliamentary vote of confidence. Here, we're stuck with senatorial gridlock until the public decides to throw out all the incumbents–or at least a third of them every two years. And that outcome is pretty unlikely.

This year, the wheels of government could become completely mired in the ooze of partisanship, once the Democrats pass health care legislation using the arcane senatorial reconciliation procedure. And if the Senate does become bog bound, most spending bills once again will be on hold until the next calendar year.

Members of Congress know full well that "continuing resolutions" hurt many programs that depend on federal funds, science among them, but election exigencies always trump prudent policies. And with Democratic control of both houses of Congress possibly vulnerable to a Republican takeover, the 2010 election looms larger than most. And the larger it looms, the more likely the legislative engine will seize up.

That the system is broken there is no doubt. The public knows it, and members of Congress know it. But fixing it is not so easy. Still here are a few ideas–in brief.

First, make congressional districts more competitive by letting the nonpartisan commissions decide on redistricting rather than politicians in state legislatures and state houses who focus on creating safe districts. Then candidates will have to appeal to voters of all political persuasions, not just their bases.

Second, take money out of campaigning. One big difference between the Congress of today and the Congress of fifty years ago is that members of the two parties today don't have time for after-work socializing. They spend every non-working hour raising money for the next election. Finding time to establish friendships across the aisle is as important as arguing on the floor.

True, the Supreme Court has struck down most campaign financing laws on First Amendment grounds. But bushels of campaign money are spent on TV advertising. And there is nothing to stop Congress from mandating that TV stations make free political advertising time available in return for receiving their licenses. Congress can also force cable operators to provide free time in return for keeping their unregulated monopoly status.

Finally, the Senate could return to the days when a filibuster was more than a threat to debate. It used to mean that senators actually had to be on the floor debating. And it used to mean that all senators had to be available for quorum calls at any time of day or night. But of course, if senators had to do that now, they couldn't be out raising campaign cash at morning and evening fundraisers. Whoever shortened 1 *Timothy* 6:10 to, "Money is the root of all evil," had it right, at least in the political arena.

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The APS Register of Historic Sites

By John S. Rigden

In the history of the United States there are events that have become part of the folklore of the nation. They bind us together as a people, they remind us where we have come from, and they inspire us to think beyond our immediate concerns. Here is a personal example. One day, walking along Vanderbilt Avenue toward 44th Street in mid-town Manhattan, I saw a plaque on the wall of the Yale Club. I went over to see what the plaque was about. It informed me that "At the British Artillery Park near this site Nathan Hale…was executed on the morning of September 22, 1776. His last words were, 'I only regret that I have but one life to lose for my country.'"

I stood there caught up with that message. I do not remember what was going on in my mind when that plaque interrupted my thoughts, but I do know that for some minutes after continuing on my way, I was thinking about Nathan Hale, the Revolutionary War, and the forefathers of the United States. The plaque had done an important job: it reminded me that people sacrificed to establish the United States and that I am the beneficiary of that sacrifice.

In 1966, the National Historic Preservation Act established the National Register to honor sites of historical significance and place a plaque at the site. The American Physical Society has initiated a similar program that has the potential of doing for the public what the Nathan Hale plaque did for me. In January 2004, the APS Historic Sites initiative was established on an *ad hoc* basis, a committee was named, and site selection began. Bronze plaques were ordered, appropriate citations inscribed on them, and soon plaques were being mounted at the honored sites.

On November 16, 2008, it all became official: the APS Council made the Historic Sites Committee (HSC) a standing committee of the APS. Five individuals were appointed to the first *ad hoc* HSC: Gordon Baym (University of Illinois), Sidney Drell (SLAC), Mildred Dresselhaus (MIT), Gerald Holton (Harvard), and John Rigden (Washington University in St. Louis). Members of the second HSC are: Katherine Gebbie (NIST), Holton, David Jackson (LBNL), Steven Weinberg (University of Texas at Austin) and Rigden. Members after January 1, 2010 will be Benjamin Bederson (NYU), Gebbie, Jackson, Weinberg, and Spencer Weart (AIP).

When the HSC began its work, we recognized that there were sites where new frontiers of physics were established and thus had national and international significance. Often the events at such sites occurred deeper in the past. These sites were obvious candidates for selection. We also recognized that there were sites where important contributions to physics were made, but which had a more local significance. The committee decided to start with "obvious" sites. Seventeen sites have been selected. T**hose selected in the first round are**

Washington University in St. Louis: Arthur Compton, Compton Effect
Franklin Institute: Benjamin Franklin
Yale University: Willard Gibbs, Thermodynamics
Case Western Reserve University: Michelson-Morley Experiment
The Johns Hopkins University: Henry Rowland, Diffraction Grating

In the second round

The Albany Academy: Joseph Henry, Self Induction
Bell Labs: Bardeen, Brattain, and Shockley, Transistor
Columbia University: I.I. Rabi, Magnetic Resonance
Harvard University: Jefferson Laboratory
University of Chicago: Robert A. Millikan, Oil Drop Experiment
MIT: The Radiation Laboratory

In the third round

University of California, Berkeley: E.O. Lawrence, The Cyclotron
Cornell University: Birthplace of *Physical Review*
University of Illinois: BCS Theory

In the fourth round

McGill University: Ernest Rutherford and F. Soddy, Radioactivity
Caltech: Carl Anderson, The Positron
Holmdel and Bell Labs: A. Penzias and R. Wilson, CMB

In a ceremony at these sites, a bronze plaque is presented by the APS President or President–Elect to a top-level administrator at the site, and the event is recorded in the APS Ledger of Historic Sites. The ceremony itself is an opportunity for the site being recognized to put physics on display and to connect with both the campus and local communities. Sadly, however, this opportunity has often been ignored. Although we do not need to showcase physics to other physicists, unfortunately it is physicists who typically make up the audiences at the plaque-presentation ceremonies. There was one notable exception.

At the presentation ceremony in honor of Joseph Henry, John Rigden looks on as the Head of the Albany Academy, Caroline B. Mason, signs the APS Ledger of Historic Sites.

At Case Western Reserve, Lawrence Krauss organized an outstanding event. The plaque ceremony was embedded in a program of well-known speakers and a panel discussion. The program was held in Severance Hall, home of the Cleveland Symphony. Physics was put on display before an audience of some 1,500 people. (At the other extreme, one plaque was presented before an audience of two–both physicists!)

Another audience that witnessed the presentation of the APS plaque was noteworthy: this audience, all high school students, filled a large auditorium. When Joseph Henry discovered self-induction in 1832, he was a high school teacher at The Albany Academy. For eleven months of the year, Henry's laboratory was a classroom. He could do his research only during the month of August. He was right on the edge of his discovery in 1831 when, once again, he had to interrupt his research and transform his laboratory back into a classroom.

Each plaque contains a brief citation that identifies what happened at the site. Following are three illustrative citations:

For Holmdel Township/Bell Labs

With this large horn antenna, Arno Penzias and Robert Wilson discovered the cosmic background radiation in 1964. This unexpected discovery, the first evidence that the universe began with the Big Bang, ushered in experimental cosmology. Historic Physics Site, Register of Historic Sites American Physical Society

For the California Institute of Technology

Near this site, in August 1932, Carl David Anderson photographed the track of a cosmic-ray particle in his cloud chamber. He identified this particle as the positron–the first known antiparticle. Historic Physics Site, Register of Historic Sites American Physical Society

And finally, for the University of Illinois

In this building, the home of the University of Illinois Physics Department from 1909 to 1959, John Bardeen, Leon Cooper, and J. Robert Schrieffer created the "BCS" Theory of Superconductivity, a great achievement of theoretical physics, in 1956-57. Historic Physics Site, Register of Historic Sites American Physical Society

People are curious, and many individuals who see a plaque mounted on a building will want to learn what it says. If plaques with citations like those above are located where pedestrians–pedestrians other than physicists!–can see them, they are likely to wander over to learn what the plaque is all about. While reading the words on the APS plaques, these individuals will be reminded that, over the years, physicists have opened the cupboards of Nature and have learned the mysteries that Nature offers. People reading the plaque near the horn antenna will remember that the universe started with the Big Bang and that evidence for this is the cosmic microwave background radiation discovered with the big horn they are standing near. The horn's large size will impress many viewers, and they might wonder whether something big, is required to discover something big, such as the radiation that fills the whole universe. Whatever they think, the experience will stick with them for some time.

Or consider a person spotting the plaque at Caltech. On reading the plaque, that individual will be reminded that the material world is made up of individual particles, that in addition to ordinary particles there are anti-particles, and that anti-particles make up antimatter; at the same time, they will be informed, perhaps for the first time, that there are particles called cosmic particles which, as the name implies, come to Earth from outer space, and that some of these particles are anti-particles. Questions undoubtedly will assert themselves: What are cosmic particles? Where do they come from? What is the positron? And who knows, later, in response to these questions, the individual may well type antimatter or positron into Google to see what he or she can learn.

I believe that physicists underestimate the public's interest in fundamental physics; that is, physics that tells them how the world works. The physics department at the Washington University in St. Louis sponsors a series of lectures on four consecutive Saturdays in both the fall and spring terms. These lectures, organized by Professor Michael Friedlander, go back many years. Every Saturday, a large auditorium fills with 200-some people. From 10:00 to 11:00 am the audience listens; after 11:00, the people ask questions and the questions go on until the speaker says, "Enough." The people are fascinated. When Friedlander circulates a questionnaire to find out what people want to hear about, they often say fundamental physics or physics that tells us how the world works. In other words, they want to hear about basic physics–of course, without all the equations. Recent examples of topics requested by members of the audience are the laws of thermodynamics, radioactivity, Bell's Theorem, Schrödinger's cat, and Olbers' paradox.

As a science, physics is fortunate. Basic physics responds to some of the big questions people have asked throughout history: What is time? What is space? How big is space? What are the building blocks of the material world? Are these building blocks unique to Earth? What is light? Where is Earth in the universe? How did it all begin? When did the universe begin? These questions make physics promotable; these questions and more like them, provide physicists with a welcome mat into the minds of the general public.

Many times I heard I.I. Rabi say, "Science exists at the pleasure of the larger public." Rabi's remark has meaning at different levels. On the crass level there is money: if elected officials –a vital part of the larger public–do not provide the budgetary support required to advance physical research, then the future of ground-breaking science is problematical. The abandoned SSC is a cogent example. On a deeper level, there are the values of science. If, for example, the larger public does not value knowledge based on experimental evidence, evidence that can be replicated anywhere in the world, then the results of science will frequently be challenged by those with strongly-held beliefs that, unfortunately, often touch the emotions in such a way that they trump hard scientific evidence.

The public has ample reason to find pleasure in the human achievement that brings understanding to our world–the world that all people everywhere call home. This pleasure, however, must be cultivated and nurtured. All existing opportunities to bring physics into the attention of the public must be exploited and new opportunities to inform the public about how physicists understand the natural world should be developed.

The APS Historic Sites Program is a wonderful way, for physics and physicists, to connect with the general public. The subject of physics connects with the public through the plaques themselves. Physicists could connect with the public by using the sites selected by the HSC as points of departure for talks designed for a general audience. On the one hand, physicists could second guess the HSC and challenge its selections. Some physicists would like to do this. On the other hand, physicists could explain to members of their community why the HSC selected particular sites. Why were Rowland's diffraction gratings, which were coveted by researchers all over the world, worthy of recognition? Almost everyone knows the name Benjamin Franklin, but how many people know that Franklin did some outstanding science?

In the history of physics there are ample examples of experimental and theoretical discoveries that have expanded the conceptual domain of physics, triggered the explorations of new and challenging frontiers, and changed in fundamental ways our understanding of the natural world. Experience demonstrates that this makes physics interesting to the public–the same public on which physics depends. Let us take advantage of this fortunate circumstance.

John S. Rigden served from 2004 to 2009 as the founding Chair of the APS Historic Sites Committee.

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