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Focus on Advocacy
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Atlanta Hosts 2012 APS April Meeting

Physicists from all over the world will soon be converging on the Peachtree State as this year's April Meeting is being held at the Hyatt Regency in Atlanta, Georgia from March 31 through April 3. The meeting will draw more than 1,000 physicists to share the latest results in particle physics, nuclear physics, astrophysics and plasma physics research. There will be 234 invited speakers and a total of 165 sessions as well as three poster sessions. In addition, the Sherwood Fusion Theory Conference will take place in conjunction with the meeting.

This year marks the 100th anniversary of the discovery of cosmic rays, and in celebration the meeting's theme is "100 Years of Cosmic Ray Physics." The meeting will kick off on Saturday morning with the Kavli Foundation Keynote session about the history and current research into cosmic rays. Leading off the session, Alan Watson from the University of Leeds will take the audience through the 100-year history of cosmic ray research and how it has impacted numerous fields of physics. Ellen Zweibel from the University of Wisconsin–Madison will highlight current research into the understanding of cosmic ray plasma

physics. Nobel laureate Samuel C.C. Ting from MIT will bring au-

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APS President Condemns Wave of Iranian Scientist Assassinations

Over the last two years, being a physicist in Iran has become a dangerous profession. Four scientists have been assassinated under suspicious circumstances. The most recent incident took place in January of 2012. In response to these attacks, APS President Robert Byer released an open letter on behalf of the Society, condemning the killings.

"The American Physical Society finds the recent wave of killings of Iranian scientists extremely troubling and welcomes the United States' condemnation of this type of violence," the letter reads. "The American Physical Society condemns acts of violence against scientists everywhere and reaffirms its commitment to international collegiality among physicists and its belief that science can be used to promote international peace."

No nation or organization has thus far come forward and claimed responsibility for the attacks. Many analysts have surmised that because they have been targeting physicists, the campaign is part of a concerted effort to slow or stop Iran's suspected clandestine nuclear weapons program. The most

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Fukushima's Legacy Debated

By Michael Lucibella

A year after the meltdown at the Fukushima Daiichi power plant, its legacy still divides scientists over the future of nuclear power. At this year's March Meeting, a special session organized by the Forum on Physics in Society, the Forum on International Physics and the Division of Condensed Matter Physics brought the two sides to the forefront.

Stephen Kuczynski, CEO of Southern Nuclear Operating Company, defended his industry. His company recently received the first new construction license to build a new nuclear power plant in the United States since the Three Mile Island incident in 1979.

"It's the safest industry that you can work in. The workers at our power plants are the safest in any industry," Kuczynski said. "We also have layers of oversight… There [are] multiple layers to detect if there is a change or degradation in the safety culture, and we can take action."

However, concerns about safety persist. On the same panel, following Kuczynski's remarks, Edwin Lyman from the Union of Concerned Scientists laid out his organization's reservations about the safety of nuclear power in the US.

"The question does come up: 'Can it happen here?' There's been a lot of debate on this issue, whether it was a Japan-specific event, whether the US was better prepared than Japan to deal with this kind of contingency. In our view, complacency is as prevalent here in the United States as it is in Japan," Lyman said. "US nuclear plants were not designed or intended to survive major natural disasters, multiple system failures or terrorist attacks."

Following the crisis at Fukushima, leaders of the US nuclear industry put together a study titled "The Way Forward" to review what happened in Japan and prevent such an accident in the United States. The document that emerged included a strategy for coping with potential accidents, which the industry referred to as its FLEX

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March Meeting Session Highlights LGBT+ Issues for Physicists

By Calla Cofield

At the 2012 March Meeting, APS hosted the first-ever session at a major physics conference on sexual and gender diversity issues. Six speakers and a very vocal audience shared a discussion about the state of the LGBT+ community in physics. [LGBT stands for lesbian, gay, bi-sexual, and transgender, while the plus sign includes other sexual orientations or gender identities including intersexed, queer, questioning, asexual or pansexual. Some organizations also list straight and cisgender (anyone who identifies with the gender they were born with) to indicate the inclusion of all sexual orientations and gender identities.]

Speakers presented results from two national surveys gathering information about the experiences of LGBT+ people in physics and academia, providing some of the first data on this subject.

Susan Rankin, Associate Professor of Education and Senior Research Associate at the Center for the Study of Higher Education at Penn State University, co-authored the first study, published in 2010,

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Free Benefit Brings the News Home to Members

The APS Weekly NewsBrief has been gaining popularity since its inception in April of 2009. The weekly emails, to which more than 2,300 APS members now subscribe, deliver a condensed summary of the week's physics news circulating throughout the mass media.

"It's a compilation of news about physics that appears in the popular press," said James Riordon, the Head of Media Relations at APS, "It's to tell physicists who subscribe what the news is reporting about physics."

The news briefs cover all fields of physics, and don't exclusively focus on stories with an APS angle. Each email contains a link to the original story, plus a brief synopsis, as well as a link back to the original journal article when it stems from an article in an APS journal. Riordon said the idea is both to keep members abreast of the latest news, and also to give the scientific community insight into how the public perceives science and physics.

"I think it's important for us to know what they think about what we're doing," Riordon said.

The NewsBrief is a benefit that is free to APS members, who can subscribe either by clicking on "Weekly NewsBrief" on the Member Services page on the APS website, or by emailing the APS membership department at membership@aps.org

More March Meeting Coverage in May

Because the March Meeting was early this year, we were able to provide two stories from the Meeting in this issue. More extensive coverage will appear in the May *APS News*.

March Meeting Prize and Award Recipients

Photo by David Fox

At the March Meeting in Boston, at a special ceremonial session, APS President Robert Byer presented 17 prizes and awards to a total of 20 individuals, and one additional prize was presented by the American Institute of Physics (AIP). In the front row in the photo are (l to r): Dimitri Basov, Laurens W. Molenkamp, Shoucheng Zhang, Charles L. Kane, Nadya Mason, Mulugeta Bekele, Richard Wilson, APS President Robert Byer, Matthew Tirrell, Kai-Ming Ho, David S. Hall, and Ian Affleck. In the back row are (l to r): William A. Eaton, Giovanni Jona-Lasinio, Stuart Parkin, Siyuan (Steven) Wang, Andreas Mandelis, Robert Cava, Justin Weber, Rachel Segalman, Eric Fullerton (AIP), and Thirumalai Venkatesan.

Careers Committee Convenes in College Park

Photo by Michael Lucibella

The APS Committee on Careers and Professional Development has the broad responsibility of coordinating affairs within the Society concerned with career and professional development in physics, and advising the Society on courses of action. The committee held its most recent meeting on March 16 at APS headquarters in College Park, MD. Shown in the photo are (l to r): Alice White, Sufi Zafar, Mark Holtz, Richard Berger, Committee Chair Gregory P. Meisner, Arnold Kritz (partially obscured), Committee Administrator Crystal Bailey, and APS Director of Education and Diversity Ted Hodapp.

Members in the Media

"Their approach is extremely powerful… This is at least a 10-year effort to make very tiny electrical wires and combine them with the placement of a phosphorus atom exactly where they want them."

***Andreas Heinrich**, I.B.M., on research by physicists at Purdue and the University of New South Wales making single atom transistors,* The New York Times*, February 19, 2012.*

"I don't think I met anyone who said I bet it's going to be true. I think the people on the experiment worked as carefully as they could, and I think they ran out of ideas of what could be wrong and they decided to present it… Maybe they should have waited a few more months."

***Edward Blucher**, University of Chicago, on OPERA's announcement that the faster than light neutrinos might be the result of loose cables,* MSNBC.com*, February 23, 2012.*

"The evidence is beginning to point towards the OPERA result being an artifact of the measurement,"

***Sergio Bertolucci**, CERN, on the report by the ICARUS experiment that they measured neutrinos going at the speed of light,* Chicago Tribune*, March 16, 2012.*

"We've lost the motivation to make it (space) a priority… I think there's always been some background activities going on. The space shuttle has been going on for several decades. But my criticism of that was that we were boldly going where hundreds have gone before. If you want to actually advance the space frontier, what you want to do is move that frontier out. Every time you do that, a whole new level of interest and curiosity is stimulated, spawned for having done so."

***Neil deGrasse Tyson**, American Museum of Natural History,* CBSNews.com*, February 27, 2012.*

"This very much smells like the Higgs boson."

***Beate Heinemann**, University of California, Berkeley, on data coming out of the Tevatron's last run hinting at the Higgs boson,* The New York Times*, March 7, 2012.*

"Unfortunately, this hint is not significant enough to conclude that the Higgs boson exists,"

***Rob Roser**, Fermilab on data coming out of the Tevatron's last*

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This Month in Physics History

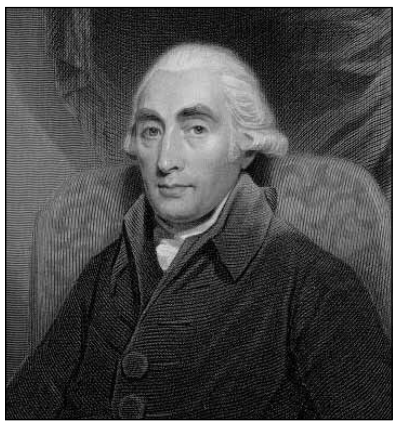
April 23, 1762: Joseph Black and Latent Heat

Disappearing heat and the dog that did not bark

***Ed. Note:** This column has been contributed by guest writer Richard Williams.*

One of the most primitive human skills, known from ancient times, is our ability to tell whether an object is hot by touching it. It feels hot because of its energy content, "sensible heat." But there is a more subtle form of heat, recognized only more recently. We can't detect it by touch, yet evidence of its existence is all around us.

Melting ice, for example, absorbs a large amount of heat without any increase in temperature. The evaporation of water absorbs even more heat without a temperature change. When the process is reversed and water freezes, or the vapor condenses, this "latent heat" returns to the environment. The latent heat stored in ice and water vapor has a profound effect on weather and climate.



Joseph Black

Early scientists were unable to grasp the concept of latent heat, which seemed to disappear and then reappear later, somewhere else. To make matters worse, at the time, the distinction between heat and temperature was poorly understood, and the instruments to measure them were crude and unreliable. Finally, however, in a brilliant leap of scientific intuition, the bizarre behavior of latent heat was unmasked by a modest Scottish scientist, Joseph Black, 1728-1799, who discerned a profound truth hidden in poorly understood and seemingly unrelated observations.

Black's attention was drawn to the latent heat puzzle by an observation on supercooled water, made by physicist Gabriel Daniel Fahrenheit, [of the Fahrenheit temperature scale.] Fahrenheit reported the now well-known fact that water can be supercooled, or chilled below the freezing point, without turning to ice. When shaken, however, the supercooled water turns instantly to ice, and the temperature rises to the freezing point.

Black meditated on Fahrenheit's experiment, and on his own observations of the slow melting of ice. Taken together, the two suggested that a large quantity of heat was absorbed as ice melts, and a corresponding quantity released by the freezing of water. Starting from this simple insight, he soon realized that a form of heat must exist that mysteriously disappears and reappears as water changes phases. Black based his reasoning in part on the fact that something expected to happen did not. [Sherlock Holmes used similar logic to solve a puzzling case by noting that a dog at the crime scene had not barked, though it was expected to.]

Before Black's work, scientists expected that if one warmed a cold piece of ice to the freezing point, a minute quantity of additional heat would melt the ice entirely. Black showed that the expected thing did not happen. In lecture demonstrations he showed that equal weights of ice and water, both at 0° C, warmed equally by the air of the lecture hall, behaved very differently. Over a period of time, the water warmed by many degrees. The ice did not melt as expected, but most remained, along with a little water, at 0° C. He used the absence of an expected effect, "the dog that did not bark", to argue the case.

He pointed out an important effect of latent heat on the melting of snow and ice in nature. "If the complete change of ice and snow into water required only the further addition of a very small quantity of heat, the mass, though of considerable size, ought all to be melted in a few minutes or seconds more. Were this really the case, the consequences would be dreadful. Even as things are at present, the melting of great quantities of snow and ice occasions violent torrents. But were the ice and snow to melt... suddenly ... the torrents would be incomparably more dreadful." The latent heat that Black discovered greatly slows the melting of snow and ice. He gave the first account of this work on April 23, 1762 at the University of Glasgow.

Having established the existence of latent heat in the melting of ice, Black turned to the vaporization of water. From his lecture notes: if a small quantity of heat added to boiling water could convert it all to vapor, "the undeniable consequence of this would be an explosion of all the water with a violence equal to that of gunpowder." Since this does not happen, he concluded that a large quantity of heat must be added, even though there is no change in temperature, "and I gave it the name, *latent heat*."

The concept of latent heat was soon applied to industrial practice. James Watt was a student of Black and cooperated with him in his work. Watt's early knowledge of latent heat enabled him to manage heat in the steam engine, improving it from a crude and inefficient machine into the powerful driver of the industrial age. With ice, recognition of latent heat allowed one to design ways to use heat insulation, so that ice could be stored for months without melting, even in the warmest climates. An industry arose in the US, shipping ice cut from northern lakes in winter to Cuba, India and other warm countries. In the early 19th century, ice was one of the most important US exports, exceeded only by cotton. Writer Henry David Thoreau, a relentless critic of technology, in 1854 expressed his disdain for both the ice export and the steam engine in a single sentence; "Men think it necessary that the Nation have commerce, and export ice... and ride thirty miles an hour; ... if railroads are not built how will we get to heaven?"

Joseph Black was born on April 16, 1728, one of twelve children. Pressed by his father to study medicine, he enrolled at the University of Glasgow, then went on to receive his medical degree in 1754

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Education Corner

A column on educational programs and publications

Award for Improving Undergraduate Physics Education

Created by the APS Committee on Education, the award recognizes departments and programs that support best practices in education at the undergraduate level. Programs will be recognized for a three-year term, acknowledged on the APS website, awarded a plaque, announced in *APS News*, and recognized at an annual meeting. These awards are intended to acknowledge commitment to inclusive, high-quality physics education for undergraduate students, and to catalyze departments and programs to make significant improvements. Nominations for the award are being accepted until July 15. More information can be found at www.aps.org/programs/education/undergrad/faculty/award.cfm

APS Excellence in Physics Education Award

The award recognizes and honors a team or group of individuals (such as a collaboration), or exceptionally a single individual, who have exhibited a sustained commitment to excellence in physics education. Nominations are being accepted until July 1. More information can be found at www.aps.org/programs/honors/awards/education.cfm

PhysTEC Solicitation for Supported Sites

The PhysTEC Solicitation for Supported Sites to build model physics teacher education programs will be released in early fall 2012. To view the 2011 solicitation, visit www.phystec.org/solicitation

Date and Location Set for 2013 PhysTEC Conference

The next PhysTEC conference will be held March 16-17, 2013 in Baltimore, MD, immediately preceding the APS March Meeting. For info on the 2013 PhysTEC conference, visit www.ptec.org

AAPT Summer Meeting

The American Association of Physics Teachers (AAPT) will be having its annual summer meeting in Philadelphia, Pennsylvania from July 28 to August 1, 2012. This meeting features sessions and workshops on a wide variety of physics education topics, and typically draws over 1,000 physics educators from universities, K-12 schools, and other institutions.

2012 Conference on Laboratory Instruction - Beyond the First Year of College

Geared toward university faculty and staff who teach intermediate and upper-level laboratory courses for physics students, the conference will provide an unusual opportunity for hands-on exposure to a broad smörgåsbord of contemporary instructional labs and for discussions of a range of curricular models to enhance the undergraduate physics major. The conference is organized by ALPhA (the Advanced Laboratory Physics Association) with support from the NSF, the APS Forum on Education, AAPT, the Physics Instructional Resource Association, ComPADRE, and the Physics Departments of the University of Pennsylvania and Drexel University. Hosted by and at the University of Pennsylvania and Drexel University, the conference will run Wednesday to Friday, July 25–27, 2012, immediately prior to the AAPT Summer Meeting. More information about the conference can be found by following the links at www.advlab.org.

ICPE Medal goes to Professor Joe Redish

Professor Edward F. (Joe) Redish has been selected to receive the International Commission of Physics Education (ICPE) Medal for 2012. This medal is awarded by the International Commission of Physics Education (IUPAP Commission C-14) "…to recognize outstanding contributions to physics teaching of a kind that transcends national boundaries."

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run hinting at the Higgs boson, Reuters*, March 7, 2012.*

"It would be a triumph of the theory to actually see that it happens."

***Gary Feldman**, Harvard University, on physicists nearing the discovery of the Higgs Boson,* The Chicago-Sun Times*, March 7, 2012.*

"We had this idea that you could use this kind of trick to probe the structure of molecules… At Kansas State, we don't have the kind of laser that (OSU researchers) have."

***Chii-Dong Lin**, Kansas State University, on using ultrafast lasers to snap an image of atoms inside a molecule,* The Columbus Dispatch*, March 8, 2012.*

"At the heart of quantum mechanics is a rule that sometimes governs politicians or CEOs–as long as no one is watching, anything goes."

***Lawrence Krauss**, Arizona State University, quoting from his recent book "A Universe from Nothing,"* The Financial Times*, March 9, 2012.*

"Although challenges still remain, I am confident that we have put into place a clear pathway for the years ahead and strategies that will support Berkeley's ongoing excellence and its impact on the world."

***Robert Birgeneau,** University of California, Berkeley, on stepping down as chancellor of the school,* The Los Angeles Times*, March 13, 2012.*

Congressional Fellow Combines Research and Communication

By Michael Lucibella

Scientific research can take on a whole new perspective when seen from the halls of Congress. APS's 2010/2011 Congressional Science Fellow, Laura Berzak Hopkins said that working in the House and Senate gave her valuable insights as to how the lawmaking process works, and how scientists can get involved.

Hopkins did her doctoral thesis work at the Princeton Plasma Physics Laboratory. There she worked on diagnostic systems for Tokamaks, data acquisition systems and data analysis. When finishing up her thesis, she heard about the APS Congressional Fellowship, which intrigued her because it seemed like a good way to combine her interests in science research and communication. From the start, working with lawmakers proved to be wholly unlike working with ionized particles.

"It was a different experience from research," Hopkins said, adding that she found there was a much greater variety of work in Congress compared to a lab. "One day I might be accompanying my boss to do a speech or give an interview, and the next day I might be going to meetings with different interest groups."

Hopkins spent the first half of her year in Congress working at the House Foreign Relations subcommittee on terrorism, nonproliferation and trade.

"I focused primarily on nuclear cooperation agreements and the current status of what some of the legislation is," Hopkins said.

After the midterm elections, the leadership of the House changed, along with all of its staffing, so she went to work for the office of Sen. Kent Conrad (D-ND). There she found her background in scientific research was put to use on energy issues like ethanol credits, comprehensive energy legislation and coal ash disposal regulations. In March, after the earthquake in Japan, she was able to rely on her training as a plasma physicist to explain some of the workings of the unfolding Fukushima disaster.

"I was primarily explaining the background of what is a nuclear power plant, is it a nuclear weapon, what is a spent fuel pool,"

Laura Berzak Hopkins

Hopkins said. "A lot of the issues related to nuclear energy were right in line with my work."

She added also that not only was her technical training itself a boon while on Capitol Hill, but the research skills she developed while pursuing her degree were as important to her success.

"It sounds trivial but I think it's a skill that scientists really hone in their daily research activities," Hopkins said.

She pointed to issues that she worked with on the Hill, including energy and pollution, as areas where scientists can have a lot of meaningful input. However she said she was a bit dismayed that more scientists and researchers don't get involved in the lawmaking process.

"I wish I saw more scientists involved in policy," Hopkins said, adding that many scientists are willing to engage the public about their research. "But what I see much less frequently is scientists coming to their local representative and their local senator… I wish I saw more of that."

Bringing scientific expertise to lawmakers is one thing, but Hopkins is also as passionate about sharing science with the public. Throughout college she gave public talks and helped with other outreach activities.

"I've always been interested in not only doing the science, but… in showing people why I'm excited about science," Hopkins said.

She's kept up her passion for bringing science to the public. This year, Hopkins received an APS Outreach Grant to set up a website to let scientists show off their research to the public. The website, titled "WhySci," will host short explanations of the work done by scientists. Written by the researchers themselves, Hopkins will help edit the descriptions by getting science journalism students involved as well.

"I think that it's a great opportunity for both scientists and non-scientists to open a line of communication," Hopkins said. "There are a lot of scientists who are extremely passionate about what they're doing, and there are a lot of non-scientists who are genuinely excited about what's going on."

Hopkins is still weighing her options for the future. Right now she's at Princeton's Woodrow Wilson School of Public and International Affairs program on Science and Global Security. She said she's thinking about getting back into physics research, but hasn't made any concrete decisions yet.

INSIDE THE BELTWAY

Can Science and Politics Coexist?

by Michael S. Lubell, APS Director of Public Affairs

Secretary of Energy Steven Chu, Nobel Laureate, National Academy member, APS Fellow and former Lawrence Berkeley National Laboratory director, is discovering just how rough Washington can be. Despite yeoman efforts on behalf of American science and technology, in less than a year he's twice found himself caught in a political bear trap.

The "gotcha" mindset is nothing new to seasoned politicians. They know it comes with the territory. But for most scientists, who are trained to speak the "truth" as the profession demands, it is revelatory.

Chu's first serious brush with the Washington hunting posse came last year, when his fingerprints appeared on the $500 million Solyndra loan guarantee. Let me be clear: he committed no legal transgression in approving government assistance to what appeared to be a promising company that in hindsight we now know made a very bad bet on the silicon futures market.

Solyndra was one of several businesses–Evergreen Solar was another–that had developed technologies requiring less silicon to produce solar power. If the price of silicon had continued to increase, they would have had investors knocking down their doors to buy a piece of their companies. But the price collapsed, and their balance sheets went completely sour.

Chu was carrying out an administration policy that Congress had authorized–providing incentives to encourage solar energy development. Opponents have challenged the wisdom of a political philosophy that injects the federal government so directly into the marketplace, but Chu's critics went even further, lambasting him for alleged impropriety.

Though his congressional detractors combed through thousands of emails, they found nary a trace of a spoor. Nonetheless Chu's reputation remained ensnared in the kind of innuendo for which Washington is famous.

The Solyndra furor had barely died down after months of hearings and accusations, when Chu once again found himself the subject of controversy, this time for a comment he made in 2008, when he was still the Berkeley lab director. This time, the context was oil, or more precisely the price of gasoline.

It's no secret among political cognoscenti that consumers blame a president for anything that goes wrong economically, whether it's soaring prices or vanishing jobs. And the electoral fallout can be catastrophic. Just ask Jimmy Carter or George H.W. Bush.

So in an election year, with gas prices threatening to climb well past four dollars a gallon, it didn't

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Letters

Readers interested in submitting a letter to APS News ***should email letters@aps.org***

Intellectual Property Belongs to Authors

In the "Bill to Kill Open Access Mandate" story in the March *APS News,* Michael Lucibella writes "Publishers who oppose it have had to walk a fine line between supporting the mission of greater dissemination of science, while at the same time protecting their investments and intellectual property." My response: "What intellectual property?" For example Elsevier demands all rights be given to them on publication, and conveniently "allows" you personal use of your own work, all for the laughable reason that "the scientific record must be clear and unambiguous." Let's be very clear and unambiguous here: we are TRIPLE paying in this case. First to publish, second to access, and third in our taxes!

Ross Mayo
Columbus, OH

Role Models Should be Sensitive to Diverse Values and Motivations

Cultural perspectives are often extremely complicated and I believe the article on PhysTEC that appeared in the March *APS News* did an excellent job in capturing some of these broad ideas. Because the concept is complex, I just want to add a few comments to amplify my remarks that were quoted in the article.

Although there is a grave need for minority physicists and physics teachers, it is my belief that minority students do not need role models that look like them in order to be successful in physics and physics teaching or to be inspired to pursue careers in those fields. Research, as well as my own personal experiences, suggests that role models need not be the same race, ethnicity, or gender as the student. However, when it comes to motivating and inspiring students, I think that more than good teaching is required. Students of diverse backgrounds and cultures, generally, have diverse value systems and motivations. Thus, teachers, mentors, and other potential role models should be cognizant of and sensitive to these differences. It may be true that individuals of similar backgrounds are more aware of these differences and how to address them. However, with effort–and possibly training–all have the capacity to be positive and influential role models regardless of background.

Geraldine Cochran
Miami, FL

Dudley Buck Remembered

It was a pleasure to see some of Dudley Buck's ingenious work reported in the February "This Month in Physics History" column in *APS News*. However, categorizing me as his "classmate" greatly overstates my then status. At eleven years older, he was a mentor, a substitute father, and a wonderful friend. His sudden death at age 32 was a crushing event.

Buck was a very early advocate of the huge potential societal benefits which would result from reducing both the size and the cost of computer components by several orders of magnitude. He was also an amazing human being, with an acute sense of humor and a propensity for clever practical jokes.

His philosophy that one should be "ambitious for the entire human race" should be a guiding principle for all of us. Interestingly enough, this philosophy can work in private industry as well as in academia. In our small but quite successful fifty-plus-person Delaware Corporation, the goal is not making money. It is "to advance humankind by doing good physics." And this policy has one hundred percent director and stockholder support. Presumably there are numerous other organizations that feel the same way. Buck was right.

Chuck Crawford
Wilton, NH
Ed. Note: *The writer is President of Kimball Physics, Inc.*

Self-interest Drives Political Loyalty

Felix Smith (letters, August/September *APS News*) cites Michael Lubell's Inside the Beltway column which quotes the PEW Foundation numbers that 55% of scientists identify themselves with the Democratic party, while only 6% with the Republican. (A lot of us are independents.) He notes that this correlates strongly with being liberal or conservative. Lubell, Smith notes, reports that the imbalance may be understandable: "Professionally and personally scientists need to be more dedicated and more sensitive to the pursuit of truth and the correction of error...scientists tend to be more idealistic–and perhaps more public spirited than the general population."

Wow! What a slap at the non-dedicated, self-interested, "uncorrected," less public-spirited, etc., Republican and independent scientists. In every income range conservatives and Republicans give appreciably more money and time to charities than do liberals and Democrats. The latter argue that instead they seek to redistribute taxpayer money through the government.

So surely the above claims re scientists are questionable, if not nonsense. Scientists are just like everyone else. Self-interest plays a big role in the DEM/GOP ratio. Most scientists at universities, national laboratories, etc. are public employees and would tend to support the party that they feel will give them more funding and support more spending. The "tax and spend tag" is clearly attached to the Dems, and public employees are a large part of their constituency. The Democrats' strategy is clear: bigger government, with more public spending and more public employees, more entitlements and more hand-outs will beget more votes. It has been working for many years.

In Congress the House defines the spending and the Dems have controlled it for 48 of the past 60 years, and controlled the Senate for 46 of those. Republicans are seen as trying to get our deficits and debt (now $16 trillion–more than our GDP) under control, which involves spending reductions (as well as revenue increases –as can be done without seriously slowing the economy).

As G. B. Shaw said: A government that takes from Peter to give to Paul can always depend on the support of Paul.

Regarding Smith's other claims: It was not Clinton and the Dems, but Clinton dragged along by Gingrich and the GOP budget balancers–who for the first time in four decades held the House–that produced federal surpluses. Large factors were defense industry reductions due to Reagan's ending the cold war, and to the economic and high-tech boom Reagan helped unleash. The tech bust, among other things, ruined Clinton's last year. Bush inherited the resultant recession–followed by 9/11.

Paul Brady
Davis, CA

PS: California is an extreme case of public employee "self-interest" where the public unions basically run this Democratic state from top to bottom. CA K-12 school performance has fallen from the top 10% to the bottom 5% in national tests. Rising carbon taxes will cripple or shutdown many industries and stunt state economic growth. And, we owe hundreds of billions for public pensions and retiree healthcare–a cost soon to average nearly $10,000 per family per year for the several million public retirees.

Regional Fuel Storage Could Lessen Radiation Hazard

As the crisis at the Fukushima Daiichi nuclear power plant unfolded, one of the greatest dangers of radiation exposure came not from the reactors but from the fuel storage pools. These giant water tanks store spent nuclear fuel rods while the rods cool to manageable levels. After the tsunami engulfed the facility, the power was knocked out, and the pumps that kept water flowing into the pools were disabled. Ultimately firefighters had to don protective suits and brave dangerous levels of radiation to run water hoses into the pools, keeping the rods from boiling away all of their protection.

A recent proposal from the American Academy of Arts and Sciences recommends a new way to mitigate the dangers of these onsite spent fuel pools. It proposes an international plan to collect spent fuel from multiple nations and consolidate them at a single safe facility.

"It's widely recognized that a nuclear incident anywhere is consequential to us all," said Robert Rosner, a physicist at the University of Chicago who helped develop the new idea.

The proposal recommends that instead of storing spent nuclear fuel in cooling pools at each plant, multiple countries ship their spent fuel to a single regional holding facility in a nearby nation. The fuel would be stored in dry cask storage while it cools off at these facilities under the auspices of the International Atomic Energy Agency. The team says this system would be easy technologically to implement, safer than pools at every power plant, more cost effective for power plants, and be able to turn a profit for the host country within two years. Countries would bid to host the site, and the one selected would collect revenues from nations whose waste it's storing.

James Malone, current chief of nuclear fuel development at Lightbridge and former vice president of nuclear fuels at Exelon Generation Company, said that the biggest challenge would be getting countries to participate, rather than any technical challenge.

"We're not doing anything new on the tech side," Malone said "This technology has been deployed at Exelon at each site." He added that spent nuclear fuel is safer in dry storage than in water.

Each of the proposed sites

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plan. According to the plan, plants acquire self-contained portable pumps, generators, batteries, compressors, hoses and equipment to clear debris. The equipment is kept onsite to deal with a catastrophic event that knocks out external power. The idea is to use the batteries, hoses and other equipment to keep water flowing over spent fuel rods and the reactor cores, preventing them from overheating.

"Let's just assume that we're not smart enough to know every single possible external event; let's develop strategies to deal with whatever they are," Kuczynski said. "It may be a flood, it may be a seismic activity, it may be something that we're just not thinking about at this point in time. But can we develop strategies to extend battery life, make sure our sources of AC power are secure, and can transport water so our ultimate heat sink can be functional? That is the whole purpose around FLEX."

Lyman said that the FLEX program did not address some of the fundamental issues that contributed to the disaster at Fukushima. He said he was concerned that a major catastrophic event, like the tsunami that struck the Japanese plant, could still knock out all of the emergency equipment stored onsite.

"The US nuclear industry has proposed a program which they call FLEX, which essentially involves buying lots of commercial grade, off-the-shelf equipment like diesel generators that anyone can buy for their home, and storing them at various places, on and off reactor sites, in the hope that no matter what event might come, that at least some equipment somewhere will survive and you'll be able to get it to the site and use it," Lyman said. "It's really not clear how much additional safety we're getting from the industry's program. And the NRC has not yet issued its guidlines as to how that equipment should be regulated."

The designs of reactors were also the subject of contention. The reactors slated for construction at Southern Nuclear's new plant are the first to use a much touted, third generation nuclear reactor, the Westinghouse AP1000. It's been designed with a number of passive safety features built in that don't need any power or operators to shut down fission reactions and start cooling the core. The system is supposed to keep the reactor from going critical for three days if emergency power hasn't been restored.

"In the AP1000 there is a pool of water on top of the containment, so if it's needed, it will stream and it will exchange the heat and that pool of water is there for at least a three day period," Kuczynski said. "All we need to do is fill it back up; it's a very simple evolution. And that's just gravity, that's just convection, that's just normal heat transfer."

The robustness of that 72 hour estimate was disputed by Lyman. He said that overall the plans developed by the nuclear industry lacked vision and flexibility for disasters outside of the imaginations of designers. Prior to the disaster in Japan, no one had developed contingency plans for such severe damage inflicted upon a nuclear plant. Lyman said that such is also the case with the new Westinghouse reactors; their safety is predicated on the entire system remaining mostly intact. One potential flaw he pointed to was if the pool of water used for cooling is punctured there would be no contingency to prevent the reactor from going critical.

"We hear a lot about the AP1000s that can cope with a 72 hour station blackout. But really that's only under the design basis of certain conditions," Lyman said. "So if you have something that's beyond the design basis of the plant, a seismic event or major flooding, then you might not be able to count on that 72 hour plan."

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take long for Republicans to realize they might have a potent campaign issue. They blasted the President for pursuing policies they claimed exacerbated the price at the pump: limiting offshore drilling, delaying approval of the Keystone pipeline that would carry oil from Canada's tar sands to U.S. Gulf Coast refineries and pushing for removal of tax incentives for oil and natural gas exploration. But although polls showed Obama's approval rating eroding, they also showed the public didn't completely buy the Republican charges.

But Chu's 2008 statement gave Republicans the ammunition they needed. Before Obama had tapped him for a Cabinet post, Chu, in explaining to *The Wall Street Journal* how consumers might be enticed to buy more fuel-efficient cars, said, "Somehow we have to figure out how to boost the price of gasoline to the levels in Europe." If ever there was a "gotcha" quote that was it.

And with the GOP drums beating the *Journal* quote to a relentless refrain, just weeks ago Chu found himself disavowing his 2008 sentiments at a Senate hearing, because he had changed his position, given the fragile state of the economy.

Has either of these episodes tarnished Chu's scientific reputation? Hardly, but together they serve as a warning to scientists who aspire to public office: Intellect and accomplishment, alone, even at the Nobel level, do not insulate you from the politics of science.

As physicists, we believe our work should live in a politics-free zone. But in reality, whenever science intersects the lives of citizens in a democracy, politics is a handmaiden, welcome or not. Consider the impending appropriations battles on the Hill.

President Obama's opening salvo, a budget request for fiscal year 2013, may not quite place science on a funding pedestal, but it does protect research and STEM education from cuts the White House has proposed for other federal programs. Yet, the Obama plan tilts heavily toward strategic rather than discovery-driven programs: toward clean energy, for example, rather than neutrino physics.

Inevitably, some critics will take issue with the White House priorities, and as they fulminate, they unwittingly will be playing in a political arena fraught with contention and debate, rather than on a science terrain where truth and beauty are the only currencies of the realm.

Scientists may harbor the hope their work can be truly free from political intrusion and intrigue, but that hope ultimately will prove false. Engaging the public and spending time enlisting support of elected officials may seem demeaning to many research practitioners, but in the end it will do more to insulate their work from political meddling than almost anything else they can do.

Biggest March Meeting Ever

Photo by Ken Cole

The so-called March Meeting, which took place mostly in February this year, shattered all previous records for attendance, with an official count of 9867 physicists taking part. (The only bigger APS meeting was the combined March and April Meeting in 1999 held in conjunction with the APS Centennial celebration.) Here new arrivals crowd the space in front of the registration desk at the Boston Convention Center as the meeting got underway on Monday morning, February 27.

Come Fly The Friendly Skies With You-Know-Who

By Alaina G. Levine

The middle seat sucks and the food is lousy or nonexistent. But why should you complain? You are flying in a gigantic tube made of tons of steel and aluminum at speeds around 500 miles per hour more than 30,000 feet above Earth. And you are doing it relatively safely and efficiently because of the principles of physics and the many principal physicists who work in various wings of the aviation industry.

From designing and building the avionic technology that ensures the plane's sensors know where it is, to managing and analyzing air traffic systems, to flying the jets themselves, physicists make more of an impact on this multi-billion dollar industry than you may first realize.

Brad Ng is just one example of a physicist working behind the scenes to make your flying experience more friendly. As the Vice President of the Air Traffic Division of CNA, the umbrella company for the Institute for Public Research and the Center for Naval Analyses in Alexandria, VA, Ng leads a team of 26 scientists, including six physicists, to examine and solve problems relating to managing and controlling air traffic for the FAA. He was recruited by CNA 23 years ago after receiving his bachelors in biophysics from UC Berkeley and a PhD in Chemistry from UCLA. Although his original focus was on naval and Marine Corps technology problems, in 1992, when CNA started taking on projects for other agencies, Ng joined the team responsible for investigating and solving air traffic challenges for the FAA.

His current position involves, in part, overseeing the work of analysts who are examining the operations of the FAA. Their work involves creating computer models that scrutinize air traffic data in an effort to understand the root cause of system delays. Typical problems involve analyzing a future season's airline schedules and anticipating where these will change the stress points in the overall air traffic network. Ng acknowledges the benefits that physicists bring to this unique problem set. "Physicists are very disciplined and methodological," says Ng. "Physics is one of those disciplines that teaches you how to solve problems employing a highly disciplined scientific approach. We look for this when we hire people."

Walter Stockwell, whose doctorate is in astrophysics and who has worked in the avionics arena since 1996 designing sensors for aircraft, concurs that his education has made a huge difference in his problem-solving approach. Not only does his background aid him with the technology design and testing (his company, Moog Crossbow, builds solid state MEMS gyroscopes), but it also helps him the area of general problem-solving. "The physics degree helps me have an analytical approach to problems," he says. Stockwell is able to "break problems down and know what is important and what's not, take real data and quantify it," he says.

One of Ng's recent projects highlights the importance of having physicists with these skills. In preparation for the trial of the "underwear bomber," the FAA Legal Department and U.S. Department of Justice commissioned CNA to reconstruct the air traffic near Detroit on Christmas Day 2009, when the bomber tried to detonate an explosive device. Ng's team's charge was to analyze the impact that the attempted bombing had on air traffic that day, as well as to study the consequences had the detonation caused the flight to crash into the Detroit suburbs. He and his colleague, who holds a degree in astrophysics, examined the FAA's radar data from that day (and "normal" days for comparison) and reproduced four dimensional images of the flight paths of every aircraft within a hundred miles of Detroit. Their findings clearly illustrated how the bomber's actions put lives in danger that day–in the airplane, on the ground, at the airport, and in several other aircraft over Detroit.

The ability to create a picture of aircraft moving through space and time has also aided Richard Schmidt in his 17 years as an air traffic controller. Schmidt, who holds a bachelors in physics and mathematics from Minot State College in Minot, ND, originally taught high school for several years after he graduated in 1984. But on a "whim", after seeing a newspaper ad for a job for an air traffic controller, he applied for it, passed a required aptitude test, and was offered a position. As an air traffic controller at small airports in Indiana and North Dakota, he supervised air traffic visually because the airports had no computers to assist them. "We had the pilot position reports and our eyes," he describes. "It was strictly old school: It was all about vectors. I had to figure out a 3D dynamic picture in my head, to keep the aircrafts separated so their vectors would not cross." The fact that he had studied physics, something which most controllers do not have in their tool box, gave him a significant advantage in these situations. After almost 20 years as a controller, Schmidt transferred to radar maintenance. "Now my physics degree became essential. It was excellent preparation for this type of technical work."

Today, despite the fact that the aviation industry is computer-driven, the ability to mentally pinpoint the locations of aircraft in space is still a skill treasured by pilots. And for Nathaniel (not his real name), who is a commercial airline pilot and a university physics researcher, his physics education has served him well in this capacity. "Flying at night (especially), I have to figure out where I am in space," he explains. And "I have to see it in a blink of an eye."

Although Nathaniel agrees his knowledge of physics has helped him, he concludes that it may actually be a hindrance in some situations. "I don't see a huge advantage of having a physics degree," he says. "As a physicist you tend to question everything. But here you do everything by the book, and don't ask why." For example, before a pilot can take off, he must determine the weight of the aircraft he is flying, and for commercial craft, it must be within certain parameters. Nathaniel's expertise in physics tells him that there is "leeway" in terms of the weight, and that the plane could fly safely if it was over by a certain number of pounds. But legally, "if you are one pound over, you don't take off, ever," he says. The same thing goes with the temperature. "I would be perfectly comfortable flying" a few degrees above what the FAA declares as the mandated temperature level for safety, says Nathaniel. "But if I go one degree over, you don't fly or you may end up in jail."

Nathaniel observes the problem as either you can fly or you can't, depending on temperature or load weight, whereas the FAA policy adds gray to the issue by circumventing the science. Ng notes a similarity in how his team approaches problems in air traffic control management. "The physics guys are the most 'black and white' of the staff," he says. "When they look at a problem they look at it as yes or no. But the government has a lot of gray." This can be a challenge for the physicists, he continues. "The squishiness of it makes the physics guys uncomfortable," says Ng. "The policy aspect may add grayness, and 'black and white' doesn't play…You have to realize that the answer you give is the best one you can but there may be gray…(physicists) are used to looking at a problem, getting a result and that's it. They look at benefits and achievements. But here, (the solution) may not be

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Focus on Advocacy

Ed. Note: *With this contribution,* APS News *begins an occasional series highlighting members' activities in public advocacy.*

John Mergo is a PhD student at Cornell University, where he investigates colloidal micron spheres used to model atomic systems. Although his research in soft matter is his priority, he finds time to participate in outreach and advocacy to impact science policy. A native of southern Ohio, he grew up with a passion for science. But he recognizes that not everyone understands the relationship between innovations such as the iPad and GPS and basic scientific research. His goal is to help people comprehend the connection. In addition to participating in Congressional Visit Days, he recently wrote an op-ed that appeared in the Chillicothe Gazette (Ohio) detailing the choices young scientists face when considering whether to stay in the United States as they advance their careers. "I've been happily surprised by the positive feedback that my op-ed has generated in the community," says Mergo.

John Mergo

Read the op-ed: http://www.aps.org/policy/resources/opeds/index.cfm.

For more information about getting involved in outreach and advocacy, contact Tyler Glembo, government relations specialist at glembo@aps.org or 202-662-8714.

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implemented for other reasons."

With all this inside knowledge about the aviation and airline industry, do these physicists still enjoy flying? Nathaniel, who was an airline instructor for 10 years before becoming a commercial pilot in 2006, clearly loves it–he does it every weekend as he manages his dual-career. When Ng flies, he likes to listen in on the conversations between flight crew and controllers using the airlines' onboard entertainment system to hear what's happening in the cockpit. He declares "I very much enjoy flying," in part because he understands what the pilots are talking about. Listening to the pilots' chatter helps him make decisions about his own personal travel arrangements and stay relaxed on delayed flights. "I know when and where to fly," he says, with a wink.

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from the University of Edinburgh. He joined the faculty at Glasgow and made most of his discoveries there. He published very little of his works. What is known about them comes from occasional public lectures and from careful lecture notes made by his students. In addition to the discovery of latent heat, he first clarified the concept of specific heat, and showed how it varied from one material to another. He also discovered carbon dioxide, and showed how it was related to other gases and to mineral carbonates. Finally, he joined the faculty at the more prestigious University of Edinburgh. His lecturing skills were legendary, models of order and precision, with demonstration experiments, always successful, attracting many students from different fields.

He died peacefully in 1799.

Uncertainty Looms Over Federal Science Spending

By Michael Lucibella

In the Obama administration's proposal for the fiscal year 2013 budget, science and engineering overall received a modest bump in spending; however, there are areas with potentially painful cuts. Overshadowing the proposed budget are looming partisan battles in Congress, a presidential election and possible across-the-board spending cuts, casting a great deal of uncertainty over the future of federal science funding levels.

According to the President's budget, funding for research and development is up about 1.2 percent. This puts the increase below the expected rate of inflation over the next year, but dramatically better than the proposed 2.4 percent cut in federal discretionary spending overall. Nondefense research and development will be getting a 5.1 percent boost while defense R&D, which usually makes up about half of the total R&D expenditures in the federal government, will shrink by $1.5 billion or 1.9 percent.

"This administration has over the years been a pretty strong supporter of science and innovation…given the budget constraints, the budget caps, the budget control acts, the looming sequestration… I think they probably did as well as they could have," said Matt Hourihan, director of the R&D Budget and Policy Program at the American Association for the Advancement of Science. "However just as there are a number of signs of continuing support, there are a number of signs of the limitations they're facing."

Energy research is one of the big winners for research dollars, while high energy physics, nuclear physics and domestic fusion research are taking a hit. Overall the Department of Energy's Office of Science got a 2.6 percent boost in its budget, with programs working on energy research getting the biggest increases. The Advanced Research Projects Agency, ARPA-E, which focuses on developing energy technology, is getting an extra $75 million, or 27.3 percent increase. Basic Energy Science, Advanced Scientific Computing and Biological and Environmental research are slated to grow by 6.6 percent, 3.3 percent and 2.6 percent respectively. Fusion Energy Sciences, High Energy Physics and Nuclear Physics are all contracting, with budgets declining 0.7 percent, 1.8 percent and 3.7 percent respectively.

"Budget issues are very real. We'd love to have larger budgets for the field we represent, but we have to live with what we can orchestrate through Congress and the administration," said William Brinkman, head of the DOE Office of Science at a recent meeting of the High Energy Physics Advisory Panel.

Under the current budget, the development of Fermilab's new flagship experiment, the Long Baseline Neutrino Experiment has been reduced and the project will likely be further stalled and possibly even canceled. In addition the Relativistic Heavy Ion Collider at Brookhaven would run for 10 weeks, down from a planned 20 this year.

The US contribution to ITER, the major fusion reactor under construction in France, is increasing by about $45 million while the overall budget for fusion research is cut, resulting in the shuttering of the Alcator C-Mod Tokamak at MIT.

NASA is getting a 3.3 percent cut overall, including a 3.2 percent cut in its science program. The James Webb Space Telescope is being supported, but at the cost of deep cuts to the planetary sciences which has already resulted in the likely end to the joint Mars exploration missions with the European Space Agency.

The National Science Foundation is set to receive a 4.8 percent increase, and NIST's scientific and technical research services would get a 13.8 percent boost.

How much of the proposed budget makes it through Congress is an open question. Budget proposals reflect an administration's policy priorities, and can be dramatically altered by Congress during the appropriations process. This administration and the current leadership of the House of Representatives have had a particularly acrimonious relationship over federal spending; however scientific research has generally received bipartisan support.

"The House Republicans are not even going to accept the bare bones of [the proposed budget]. They're going to pull this thing apart completely," said Michael Lubell, APS Director of Public Affairs. "I don't believe there is going to be any budget whatsoever until at least after the election."

If no budget is passed by Congress, it is likely that they will pass some kind of continuing resolution, keeping the government operating at 2012 spending levels until a final budget is passed.

The fallout from the Budget Control Act of 2011 is the biggest wildcard facing federal budgets at all agencies. According to the act, after the failure last Fall of the so-called "Super Committee" to come up with a plan to reduce the deficit, significant across-the-board cuts, called sequestration, would set in starting January 2nd of 2013. The cuts include 8 percent reductions in non-defense discretionary spending, and 11 percent reductions in defense spending.

"Sequestration–that is an absolutely open question," Hourihan said. "There are real risks for science and engineering funding."

As it stands, the President's budget does not factor in the cuts, and it is unclear how and where cuts will be introduced. It's also possible that Congress can opt to ignore its own mandate for cuts.

"If it comes to pass, I think people will be shocked," Lubell said. "They [Congress] can do whatever they want."

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diences up-to-date on research being conducted by the Alpha Magnetic Spectrometer onboard the International Space Station.

Nobel Session

Monday morning's Nobel session promises to be engaging and enlightening. Two of the winners of the 2011 physics prize, Saul Perlmutter from the University of California, Berkeley and Adam Reiss from Johns Hopkins have both been invited to speak about their discovery that the expansion of the universe is accelerating. One of the 2004 Nobel laureates, Frank Wilczek of MIT, will discuss the implications that a potentially low-mass Higgs boson will have for theories of supersymmetry (Session P1).

Plenary Session

The third plenary session of the meeting, on Tuesday morning, features a range of topics. Krishna Rajagopal from MIT will describe how string theory is being used to describe the properties of hot quark soup at RHIC and the LHC. Zheng-Tian Lu from Argonne National Laboratory will highlight how laser-based atom traps are being used for Atom Trap Trace Analysis which could enable researchers to develop an effective method of krypton-dating groundwater and ancient ice. Judith Curry from the Georgia Institute of Technology will talk about how the Berkeley Earth Surface Temperature Project has brought together more than a billion historical temperature readings from around the world to produce a method to more accurately calculate the history of global climate.

Neutrino Research

New neutrino results are big at this year's meeting. Bradford Benson from the University of Chicago will present the first evidence of a 4th generation of neutrino discovered by the South Pole Telescope (Session W3.02). Recent results from the Daya Bay Experiment which uncovered the value of the theta one-three mixing-angle of neutrino oscillations will be presented in session G10.

Gravitational Waves

The hunt for gravitational waves continues, and session L6 will bring focus on new developments in the various searches as well as efforts to further refine general relativity. Nicolas Yunes of Montana State University will give an overview of his work developing new devices to look for evidence of gravitational waves around binary star systems. Later, John Conklin from Stanford University will present the latest results from the Gravity Probe B mission, launched in 2004.

Energy for the Developing World

As renewable and green energy becomes more affordable, physicists have been working on ways to bring cleaner energy to the world's poorest billions. Ashok Gadgil from the University of California Berkeley will share his work developing a cheap, energy efficient and low carbon emission biomass stove for use by displaced people around the world. Kurt Kornbluth from the University of California at Davis has been developing inexpensive solar powered lights for unelectrified houses and huts. Jeffrey Nelson and his colleagues at Sandia National Laboratories have developed what they call "solar glitter," a new way of creating photovoltaics made from crystalline silicon that uses much less semiconductor material, but maintains its efficiency (Session H6). The second session of the series looks at power generation at an industrial scale. Chris Lyons from Solar Turbines Incorporated will talk about how to generate electricity using already existing biomass and other wastes. Trudy Forsyth from the National Renewable Energy Laboratory will show the promise that wind power holds for developing nations (Session J12).

Nuclear Detection

Warren Stern from the Department of Homeland Security will highlight some of the recent developments in radiation detection technology. Michael Kuliasha from the Defense Threat Reduction Agency will focus on overarching strategies being employed by the United States to reduce the threat of nuclear terrorism and proliferation. Michael Larson will describe the history of the Nuclear Emergency Support Team, a team trained to respond to any kind of nuclear incident in the country (Session Q5).

ANNOUNCEMENTS

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recent victim, Mostafa Ahmadi-Roshan, was a chemical engineer at Iran's uranium enrichment facility. Iran has variously accused Israel and the United States for the attacks.

Hossein Sadeghpour, a physicist at the Harvard-Smithsonian Center for Astrophysics and chair of the APS Committee on International Freedom of Scientists, said that the APS had to speak out because of the implications such attacks have for scientists globally.

"The issue is that scientists should be given the freedom to do science," Sadeghpour said. "This should be true everywhere, not just in the United States or in some other favorite nation, but everywhere… Even during the Cold War, both the United States and the Soviet Union refrained from targeting their scientists."

In addition, he said that such attacks will only alienate Iran more.

"If we want to bring Iran back into the community of nations, we must address the plight of the Iranian people, and in particular the plight of the scientists. They're not working in very ideal environments to begin with," Sadeghpour said.

The full text of President Byer's letter is on the APS website at http://www.aps.org/about/governance/letters/assassins2012.cfm .

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would store up to about 10,000 metric tons of spent fuel in a number of hermetically sealed steel cylinders while they cool enough for other disposal methods. One facility should take up about an acre of land.

The idea for the facilities is that each would be owned and run by a local management agency that strictly conforms to IAEA standards. Nations would ship their spent nuclear fuel and pay a fee for onsite storage, earning a profit for the host country.

According to the plan, the first such regional facility could be open and ready for business as early as 2023. Logistical issues such as where such a facility might be located and other liability issues have not yet been addressed.

The proposal is fully described in a report available on the website of the American Academy.

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titled "The State of Higher Education for Lesbian, Gay, Bisexual & Transgender people." The survey aimed to gather information about the "climate" toward LGBT+ people in academia, and collected information from over 5,000 academic faculty, staff, administrators, undergraduate and graduate students. In her abstract for the session, Rankin demonstrated how that climate can have a negative impact not only on the individual, but on the institution and the field.

"It has long been understood–an understanding that has been well supported by research-based evidence–that institutional "climate" has a profound effect on any academic community's ability to carry out its tripartite mission of teaching, research, and service," wrote Rankin. "The research also suggests that a challenging campus climate exists for LGBTQQ students, faculty and staff. Based on the literature, a challenging climate leads to decreased productivity, decreased sense of value to the community, decreased retention, and negatively influences educational outcomes."

Overall, the study evaluated how comfortable LGBT+ people feel in academia, how negative behaviors can affect them (physically, psychologically and careerwise), and then used that data to identify strategic initiatives to improve campus climates.

At the APS session, Eric Patridge, a postdoctoral fellow at Yale University, and Ramon Barthelemy, a graduate student in physics at Western Michigan University, spoke on behalf of Rankin, who was unable to attend. Patridge is also the founder of oSTEM ("Out" in Science, Technology, Engineering and Mathematics), an "LGBT-affirming corporation" that offers support and resources for STEM students and professionals.

Among the non-transgendered faculty who responded to the survey, the highest number of "out" faculty (open about their sexual identity) came from the STEM fields. But because sexual orientation and gender identity are self-reported, and because there are no substantial data sets to which to compare the new results, there is no way to know how the number of LGBT+ people who completed the surveys corresponds to the actual number of LGBT+ people in academia. What is notable about the high number of STEM responders is how drastically it differs from another anonymous study from 2003, which Rankin says received negligible responses from LGBT+ STEM faculty.

The survey results showed a negative correlation between STEM faculty members' level of comfort and their "outness," or how open the person is about their sexual identity. "Meaning," said Barthelemy, "the more 'out' the faculty members were, the more uncomfortable they were." LGBT+ STEM faculty who felt uncomfortable in their department were 14.3% more likely to leave their institution.

Elena Long, a graduate student at Kent State University and past Member at Large on the Executive Committee of the APS Forum of Graduate Student Affairs, reported results from what appears to be the first survey to collect data specifically on the LGBT+ community in physics. The new survey, conducted in 2011 and not yet published, was open to anyone working in or retired from physics in academia, but was aimed mostly at graduate students. It asked responders to identify various aspects of their identity including gender and race, as well as sexual orientation and gender identity. The survey received just under 600 responses, nearly 100 of which identified as LGBT+. The study provides a more detailed look at minorities in physics by analyzing overlapping identity factors. For example, gender identity ranked as a top reason for feeling unsafe; Long then proceeded to look at how that statistic played out when broken down by gender, race and disabilities. The results point to the fact that many people in physics may fall into multiple minority categories.

In 2009, Long had searched for resources for LGBT+ people in physics and found next to nothing. The National Organization of Gay and Lesbian Scientists and Technical Professionals (NOGLSTP) hosts caucuses of chemists and mathematicians, the ACS has a Gay and Transgender Chemists and Allies Subdivision, the American Astronomical Society has the Working Group on Gay and Lesbian Equality, and the LGBT astronomy community hosts an "Outlist" identifying openly LGBT+ professional astronomers. There is, however, no equivalent group, caucus or list for physics.

Long founded a resource and networking website called LGBT+ Physicists. Following the 2011 March Meeting, she and some of the other physicists managing LGBT+ Physicists came together to organize the diversity session, with help from APS Director of Education and Diversity Ted Hodapp, APS Career & Diversity Programs Administrator Arlene Modeste Knowles, the APS Committee on the Status of Women in Physics, and the APS Committee on Minorities.

It is only in recent years that the STEM fields have recognized LGBT+ people as a minority group, in need of the same support as other minority groups. Speakers and audience members noted the importance of the APS session toward that end, calling it "historic."

"Inclusion of LGBT in science and engineering diversity discussions is new," said speaker Janice Hicks, Deputy Division Director at NSF, Division of Materials Research. "Knowing when to raise LGBT issues, so that they will be successful, has been difficult. In my opinion, based on what I've seen in the past year, LGBT issues are coming up now."

In approaching LGBT+ issues in physics, speakers and audience members noted that they frequently receive comments such as, "It doesn't matter what someone's sexual orientation or gender identity is. Why are you making it an issue?" and "You're being too sensitive." But the results of the climate survey and the national climate toward LGBT+ people indicate otherwise. Less than half of all US states explicitly protect against employment discrimination based on sexual orientation, and even fewer protect based on gender identity. LGBT+ people face a daunting list of challenges on issues that many non-LGBT+ people take for granted, including federal spousal benefits, health insurance coverage, partner emigration and immigration, and benefits packages.

As was noted at the session, the APS Policy on Equal Professional Opportunity, adopted by Council in 1994, includes protection for persons based on sexual orientation, but does not explicitly mention gender identity.

Hodapp responded by saying, "Because we're a member organization and we want to serve the members, we need you to speak, and say, this is the thing we would like APS to do. We are happy to facilitate that, but we want it to come from the members because we feel that it's much stronger if it comes that way."

Speaker Michael Ramsey-Musolf, a professor of physics at the University of Wisconsin-Madison and a former member and Chair of the APS Committee on the International Freedom of Scientists, argued that workplace discrimination toward LGBT+ people, sometimes known as the "lavender ceiling," is also a human rights issue. Ramsey-Musolf highlighted a section of the Universal Declaration of Human Rights set out by the United Nations, which states that everyone, as a member of society, has the right to the free development of their personality.

The presence of the lavender ceiling, like the glass ceiling, can mean the difference between promotion and stagnation. Ramsey-Musolf then added, "So if we think about those human rights—the social and cultural rights indispensable for free development of one's personality–that's the antithesis of stagnation … So the lavender ceiling is an impediment to that basic human right."

Personal action and support for the LGBT+ community has already had an impact on the growing number of LGBT+ physicists who are willing to step up and share their stories. For as much work as there is to be done, most of the speakers also expressed hope moving forward.

"In my own career," said Ramsey-Musolf, "despite many moments when I was ready to leave, had it not been for key allies who are not sexual minority members, but who understood my scientific potential and were willing to stand up for it, to put themselves on the line, I would not be here. And so this gives me a lot of hope and optimism about the future in our field, that people who recognize good science are not willing to let prejudice and stereotypes stand in the way."

The Back Page

Thinking Seriously about Doctoral Education in Physics

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Worrying Trends

Despite having an exceptional history of producing world-leading researchers, graduate physics education in the US faces stiff challenges. While the number of doctorates awarded has increased since a historic low around 2000, overall growth in physics PhDs has been stagnant since the great boom of the postwar era and has not kept up with the growth in many other STEM disciplines. Compounding this problem is the fact that the number of PhDs awarded to US-born citizens has been stagnant or declining for some time, which is a worrying trend for policy makers and those concerned with long-term US economic prospects. For our community, the decline in physics interest among domestic students and the consequent drop in persistence through graduate school is a concern because it implies that we may not be recruiting and retaining students who have the potential to thrive in future physics pursuits. Compounding this issue, as growing economies around the world develop more competitive research communities, it will become more difficult to retain the most highly-skilled individuals, especially those who were not born in the US.

As has been discussed before, there are persistent concerns about underrepresentation which are more of an issue in physics than most other STEM disciplines. The representation of women in physics is increasing, albeit quite slowly: currently, only 19% of doctorates are awarded to women. Less well articulated has been the continued failure to attract and retain representative numbers of students from traditionally underrepresented racial and ethnic minorities (a total of 6% of doctorates are awarded to African-American, Hispanic, and Native American students *combined*). Furthermore, these numbers are not appreciably changing; they may, in fact, be declining slightly. Additionally, there is a proportionately larger drop in minority student enrollment between undergraduate and graduate school–a drop from about 10% to 6%. This "gap" in participation promises to become increasingly problematic for physics as the US population becomes more diverse with a larger fraction of college students coming from currently underrepresented groups. It is also a concern for these students since the perceived barriers in physics limit their access to the social and economic capital associated with being an active participant in the discipline.

The Doctoral Experience

Similar to other STEM fields, the time needed to get a physics doctorate is getting longer on average. This is due, at least in part, to the increasing specialization of most research disciplines. Thus, new researchers must spend more time and effort learning what has been done in the past and getting to "new" findings. But this reality also means that students must spend an ever-increasing fraction of their lives getting "prepared" for their research careers. At the same time, the education system, research faculty, and, effectively, education funding sources must invest greater effort and resources in the education of graduate students. It is difficult to track retention rates exactly, since doctorates are not of a fixed duration, but it appears that approximately 1 in 3 of those who begin a doctorate in physics do not complete it. Some will leave with an MS; others will not. While we should not expect retention rates to be 100%, we should also not be callous or ambivalent about retention rates given the substantial amount of time and resources invested by students, faculty and administrators in graduate education. The dearth of data on what works best should compel investigations into how to organize graduate programs to effectively find and prepare researchers with the least amount of "unnecessary" delay.

Studying graduate education, however, is in some ways more difficult than studying physics education at the K-16 levels. By its very nature, graduate education is more specialized and individualized than other levels of education. A thesis or dissertation should be a unique and substantial contribution to the scientific corpus. Thus, in certain respects, we should expect the variance in graduate experiences to be greater than at other levels of education. However, there are well-known "canonical" experiences in graduate programs regarding, for example, course taking, publication expectations, and research-group practices so, as we and other researchers have shown, the concerns of graduate programs are amenable to analysis.

Several years ago the physics community was given another very big reason to be concerned about the realities of graduate school. In 2004, APS reported on the findings of a task force that was formed in the wake of a few high profile data falsification scandals. The task force conducted a survey on ethical abuses, and, perhaps surprisingly, found that "unethical treatment of subordinates" was a widespread concern among junior members with somewhat disturbing descriptions of such treatment. This further emphasizes the need to think carefully about the nature and structure of graduate education in physics. In many respects, graduate students are the engine driving research in many laboratories and research groups. It behooves us to ensure that they are treated with proper respect and consideration.

Peeling Back the Layers

In our research on graduate education[1], we have tried to shed light on some of these concerns. One important finding of our work, which goes to questions about recruiting students and preparing them for research careers, is that students' motivations matter: the reasons that students choose to pursue graduate school has a measurable and significant influence over their career outcomes. Specifically, we found that students who go to graduate school primarily because of their intrinsic interest in thinking about science (rather than due to receiving good grades, fellowships, family encouragement, and a host of other motivations) become more productive scientists, as measured by their publication and funding rates. While true scientific productivity is difficult, if not impossible, to faithfully and comprehensively measure, we can interpret publication and funding rates as partial proxies for scientific output. The importance of this finding lies in recognizing the reality that student motivations are often ignored throughout the education system and, especially in graduate school, it is often taken for granted that students have enough of the appropriate drive to succeed. Instead, these results indicate that we should be encouraging and providing mechanisms for students to develop their intrinsic motivations towards physics as this will likely lead to a deeper lifetime attachment to learning and discovery and, ultimately, scientific progress.

In addition, external structural factors play a significant role in sustaining engagement. As mentioned, doctoral completion times are important (especially in the minds of currently-enrolled students!) and they have steadily risen in recent decades. These times have consequences for students' careers. For men, we found that, controlling for a number of factors expected to influence salaries (for example, field, type of employer, seniority, etc.), quick finishers have greater salary prospects. Disturbingly, for women, this is not the case: on average they earn the same salaries independent of their doctoral completion time, which is at the low end of the salary scale for men. On the other hand, surprisingly few student factors significantly influence completion times (for example, gender, motivations for graduate school, prior research experiences, etc., do not affect completion) but departmental- and institutional-level factors certainly do (such as required course-taking, teaching loads, etc.). The evidence points to the fact that doctoral completion times are, in large part, out of the control of individual students; however, they do affect the career prospects of *men*. For *women*, it appears that gender-bias effects have a deleterious effect on their prospects regardless of doctoral completion times.

It is important to consider how this latter finding actually comes about in practice: it may be that potential employers, faculty advisors/mentors, or female students themselves undervalue their potential and, subsequently, do not receive the best offers and/or do not negotiate the employment terms they deserve. To some extent, all three of these factors may have an effect at different times. However, the important aspect to keep in mind is that in our data and elsewhere there are no measurable differences between women and men in terms of their actual scientific merit and productivity through the end of graduate education (and beyond), so these gendered effects require further study and attention in order to eliminate their impact. Furthermore, the link between doctoral completion time and salary for men is also troubling given that doctoral completion time appears to be largely independent of a student's true merit. Thus, caution is necessary when considering completion time in the evaluation of an individual's potential. For example, those who undertake riskier research topics, use less well-developed methodologies, or join large, multiple-institution projects may experience delays for reasons that are completely meritorious.

Looking Forward

While interviewing scientists around the country, one of our observations was that many faculty mentors tend to replicate their graduate school experiences, regardless of whether they reported their experiences to be positive or negative. If their experiences had been positive, then they saw themselves as providing similar benefits to their students; if negative, they often took the position that the experiences were somehow necessary, formative, and/or beneficial ("building character"). This highlights the tendency for graduate practices and structures to be reinforced over time whether or not they are beneficial for learning. By continuing to conduct careful and detailed research into graduate education, we can hope to better understand the effect of different practices, uncover why and how they influence graduate education, and make policy recommendations based on evidence.

One initiative that may shed light on the process of graduate education and help to alleviate some of the representation problems of physics is the current effort by APS to develop a "Minority Bridge Program" (MBP) for students from traditionally underrepresented backgrounds. Among other activities, this program will build recruiting relationships and faculty partnerships between doctoral-granting institutions and undergraduate institutions that have had success in attracting and preparing minority students towards bachelor's degrees. Through "bridging experiences", the program will help students who have the potential to succeed in a doctorate transition from their undergraduate institution to a doctoral-granting institution. Given the small numbers of minority students who currently receive doctorates, the MBP provides a real opportunity to realize the APS goal of bringing the proportion of minority students at the PhD level into parity with their undergraduate representation by 2020. Beyond the direct impacts, the initiative also promises to be useful in helping us to understand how better to prepare all students, regardless of race, ethnicity and gender, to transition from undergraduate to graduate studies. This is critically important if we are interested in expanding the pool of talent to those who may not have been able to navigate the traditional hurdles (for example, the GRE, inadequate undergraduate preparation, comprehensive exams, etc.) despite having the potential to be exceptional physicists.

What is the future of doctoral education in physics? Will our community take advantage of these and other opportunities to grow and improve the preparation of future researchers and educators? Only through concerted effort and careful research can we hope to mirror the ongoing successes of reform in undergraduate physics education. However, with a growing number of researchers taking doctoral education seriously and with the weight of professional societies like the APS behind this work, we can be cautiously optimistic that these efforts will begin to transform graduate education in constructive ways.

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1. See, for example, Geoff Potvin & Robert H. Tai, Examining the relationships among doctoral completion time, gender, and future salary prospects for physical scientists. *Journal of Chemical Education*, 89(1): 21–28, 2012; Zahra Hazari, Geoff Potvin, Robert H. Tai, & John Almarode. For the love of learning science: Connecting learning orientation and career productivity in physics and chemistry. *Phys. Rev. ST Phys. Educ. Res.*, 6(1):010107, May 2010.

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