APS NEWS

A PUBLICATION OF THE AMERICAN PHYSICAL SOCIETY • WWW.APS.ORG/PUBLICATIONS/APSNEWS

December 2010
Volume 19, No. 11
www.aps.org/publications/apsnews

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Budget Cuts Threaten Physics Programs

By Michael Lucibella

Budget woes in states across the nation have led to at least four schools closing down physics or physics-related majors.

Because of shortfalls in revenue, state boards of education have been forced to scrutinize the academic programs offered at schools and universities under their purview." The result is that universities have had to make significant budget cuts," said Theodore Hodapp, APS Director of Education and Diversity. "Physics is almost always on the chopping block because of the small number of majors at these smaller schools."

Universities have had to take a hard look at enrollment in their offered courses, and often they've scaled back the physics programs, either by cutting certain physics-related majors, or physics majors themselves.

Hit hardest by state cuts is the Northwestern State University in Natchitoches, Louisiana, which dropped eight degree programs including its physics major, its chemistry major, its physics education major and chemistry education major.

"They've terminated both physics and chemistry, along with a couple of other programs at the end of the spring semester," said Paul Withey, the head of the physics and chemistry department,

All the full-time positions will be cut, and the school plans on hiring instructors to teach the basic and service courses. Tenure has been revoked for professors in the affected departments. The university offered instructor positions to the formerly tenured faculty at a significant pay cut, but those affected have shown little interest in the offer.

"It took us all by surprise that not only would all the programs be eliminated, but also all the faculty," Withey said "Physics is such a fundamental science, and it applies to all the other sciences and engineering. It doesn't make sense for a university to completely eliminate the degree."

Missouri has also had to cut out the physics major at Northwest Missouri State University in Maryville, MO.

"The governor of Missouri ordered a program review of all campuses in the state of Missouri system and said he'd consider eliminating all programs that graduate less than ten students a year," said John Shaw, an associate professor of theoretical physics at Northwest Missouri State. "At Northwest they have eliminated a number of programs, of which the physics program was one." The physics program at Northwest Missouri State graduated on average between one and two undergraduate majors.

"It was primarily because of low graduation rates in those areas," said Douglas Dunham, Provost of the university. "It was hard to argue at the state level over the last four years that it was a pro-

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Texas-Size March Meeting Heads for Dallas

The March Meeting of the American Physical Society is coming to the Dallas Convention Center in Dallas, Texas from March 21 through the 25, 2011. The yearly meeting is the largest annual meeting of physicists in the United States and will feature more than 100 invited sessions, 550 contributed sessions, over 7,000 papers presented, and more than 7,500 people attending. The meeting highlights the latest research from the APS divisions of Atomic, Molecular and Optical Physics; Biological Physics; Chemical Physics; Computational Physics; Condensed Matter Physics; Fluid Dynamics; Materials Physics; Physics of Beams; and Polymer Physics, as well as the topical groups on Statistical and Nonlinear Physics, Magnetism and its Applications, and Quantum Information.

In addition to the extensive scientific program, other fun and engaging events and activities are slated for the meeting. Several celebratory sessions will be sponsored by DCMP, DMP and the Forum on the History of Physics in recognition of 100 years since the discovery of superconductivity. The day before the meeting kicks off, tutorial sessions will be held on the hottest topics in physics, including, spintronics, complex oxides, topological insulators, microfluidics, graphene, new directions in biological physics, quantum simulation, computing with atoms, and GPU programming applied to condensed matter physics. At the same time, workshops on polymers, education, industry, and careers will be held as well. Attendees interested in enrolling in a tutorial or work-

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PhysicsCentral's New Look Enhances Content Access

The APS website for the public, PhysicsCentral, is sporting a face lift designed to make its content more attractive and easier to find.

The site now features a more clean and open look. All of the original content is still there for people to browse, including bios of noted physicists, the Physics Buzz Blog and Physics in Action articles; however, it's been reorganized to allow for easy access.

"Previously we felt the PhysicsCentral website looked like a box of crayons," said APS Outreach Specialist Tassia Owen, who helped spearhead the redesign. "It was confusing and not very clean. We wanted to make it more user-friendly and update the feel of the website."

Coincidentally, the website's redesign came just as PhysicsCentral was picked as a finalist for the Web awards on the Institute of Physics website phys.org. PhysicsCentral was listed at the site as one of the five finalists for "Best Kid's Site" and Physics Buzz was a finalist for the "Best Blog" category.

"It's really exciting to be at the forefront of physics websites for kids," Owen said, "Hopefully the redesign will help spark that interest in kids as well as adults and this is a great way to get the word out."

The new website prominently features a rotating carousel of features just below the redesigned banner at the top of the page. Below that is an interactive icon bar that links to articles tagged with different physics concepts such as "Forces & Motion," "Quantum Mechanics" and "Chaos." The Buzz Blog has been given a new home in the center of the page, between the "I Am a Physicist" section and the physics poll.

On the new site, there are few visual barriers as the eye moves across the page. In the previous design, each feature was sectioned off into its own panel. The new version eliminates almost all panels and softens the color scheme to make the overall site less visually intense.

"If I had to pick one word, it's 'light'," said Krystal Ferguson, the designer of the site when asked to describe its new look. "I think the lightness lets you go right to the content. It's content focused."

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Have an idea for an outreach program? Need funding to start one? Then apply for an APS outreach grant. Awards up to $10,000. Deadline: January 10th, 2011. www.aps.org/programs/outreach

Advocates Worry over Science Funding

By Michael Lucibella

Advocates for science are nervous about the uncertain future of science research funding following the 2010 midterm elections. Although experts admit that the future is far from certain, supporters of federal science funding have expressed concern that many of the new members of the House of Representatives and the new Republican leadership's "Pledge to America" will favor budget cuts over support for research.

Experts also point out, however, that a contentious debate over science funding is relatively new to Congress.

"Science funding in general has been a pretty non-partisan topic. Both sides seem to see the benefit of R&D investment," said Patrick Clemins director of the R&D Budget and Policy Program at the American Association for the Advancement of Science.

Historically, funding for basic research has not been among the most partisan issues. Arguably the differences that have emerged over time are that Republicans tend to favor defense-related re-

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Science at the Market: Locally Grown

Photo by Rick Kubetz

On two weekends earlier this fall, physicists from the University of Illinois added science to the items being purveyed at a local farmers' market in Urbana. Patrons of the market, and especially children, were urged to stop by the physicists' booth, see some demos, and ask questions. In the picture, Nobel Laureate Tony Leggett (left) explains a tricky bit of physics to an interested passerby. The event was organized by Inga Karliner of UIUC.

Members in the Media

"Being able to deal with extended periods of bad luck or things not going well is something that's also required to be a physicist…I think there is an element of emotional control that perhaps physicists learn."

***Jeff Harvey**, University of Chicago, on why there are so many physicists that are pro-circuit poker players,* NPR, *October 23, 2010.*

"You would really need something the size of a Soviet H-bomb to have effects that cross many states."

***Yousaf Butt**, Harvard-Smithsonian Center for Astrophysics, on the dangers of an EMP doing serious damage to the United States electrical grid,* USA Today, *October 26, 2010.*

"Districts are drawn like fortresses for incumbents of both parties."

***Charles Munger**, talking about his support of a ballot initiative in California to allow a citizens panel to redraw district voting lines,* The Los Angeles Times, *October 29, 2010.*

"We must live up to the dream of 25 years with a lot of seriousness, even if we are like little kids in the candy store with all this data around."

***Maria Spiropulu**, CERN, on the possible discoveries at the LHC,* The New York Times, *November 2, 2010.*

"Light is quantized, and you can't count half a photon."

***William Bialek**, Princeton University,* The New York Times, *November 2, 2010.*

"It's very simple to control… You don't have all these joints."

***Eric Brown**, University of Chicago, on a robotic hand he developed that uses what looks like a stress ball to grab objects,* The Washington Post, *November 2, 2010.*

"This university, as far as I can tell, has never been on the mayor's radar."

***Allen Lee Sessoms**, University of the District of Columbia, on the former mayor of Washington DC.* The Washington Post, *November 4, 2010.*

"That's not how the question phrases itself…The question is: why is everyone else so stupid?"

***Freeman Dyson**, the Institute for Advanced Study, on whether he ever asked himself as a child why he was so gifted,* The Atlantic Monthly, *November 12, 2010.*

"What we found is that the cat uses fluid dynamics and physics in a way to absolutely optimize tongue lapping and water collection."

***Jeffrey Aristoff**, Princeton University,* The Washington Post, *November 12, 2010.*

APS Launches Webinar Series

By Gabriel Popkin

Long renowned for its real-world conferences, APS recently took a new step into the world of virtual meetings by launching a webinar series. A webinar is an interactive seminar conducted over the Internet, with audience members participating by computer or phone.

In a typical webinar, the leader delivers a talk accompanied by a PowerPoint presentation that participants can view on their computer screens. The talk is streamed over the Internet, and attendees can also listen by phone. At any time during or following the talk, participants can type in questions. After the talk is over, a moderator poses the questions to the presenter, who can then answer them for the entire audience.

APS held its first webinar in October for faculty who were interested in applying for funding from the Physics Teacher Education Coalition (PhysTEC), a project led by APS and the American Association of Physics Teachers. The webinar was led by Theodore Hodapp, APS Director of Education and Diversity and PhysTEC project director, who provided information on how to create a successful proposal. By publicizing the event to members of the Coalition and others in the physics education community, the project attracted an audience of 94 people.

Also in October, APS held a webinar entitled "Career Alternative for Physicists: Patent Law," led by Hay Yeung Cheung, a patent attorney who has a PhD in physics. This event was publicized through the Society of Physics Students and APS Forum on Graduate Student Affairs, and attracted

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This Month in Physics History

December 20, 1900: *Nature* reports on William Duddell's "musical arcs"

By 1900, the streets of London were lit entirely by electric means. The lamps did not use incandescent light bulbs, however, even though Thomas Edison had invented them by then. Those bulbs were very new, still quite inefficient, and too dim to illuminate London's dark streets and alleyways, although they proved ideal for indoor lighting. So London street lamps used carbon arc lamps, generating light via a continuous electric spark.

The effect had been known since the early 1800s, when scientists started building the first large batteries and noticed that electric current jumped across a gap in a circuit from one electrode to another, producing a brilliant light in the process. British chemist Humphrey Davy is credited with inventing the arc lamp. In 1809, he connected two wires to a battery, and used charcoal strips as electrodes. This created a sufficiently intense light for illumination, and Davy's arc lamp became a popular component of his public lectures.

The Telharmonium in action.

Arc lamps were not immediately suitable for street lighting. They required large batteries or generators, and the batteries depleted quickly because of the large currents used. So arc lamps were costly to operate, and the light fluctuated far too wildly to be of practical use. The intense heat of the arc also ate away the electrodes until the gap became too great for a spark to jump across. Generators became widely available in the 1840s, and Russian inventor Paul Jablochkoff devised a version in 1870 that used two parallel carbon rods to lengthen the service life. Arc lighting debuted in Paris in June 1878 as part of an exposition, and soon found its way to London and the US as well.

Such systems required daily maintenance by a small army of technicians, and arc lamps weren't practical for indoor use, but the only real remaining problem was a constant humming noise–a byproduct of the generated sparks. An English physicist named William Duddell set out to find a solution, and ended up inventing the first fully electrical instrument.

Born in 1872, Duddell was privately educated in both England and France, but his knowledge of electricity came not from formal studies, but from a natural curiosity about how things worked. He was apprenticed to an electronics shop as a teenager, eventually teaching at the City and Guilds Institute in London, where he received much of his education. He had a knack for invention, too, building an oscillograph capable of photographic recording and observing of oscillating frequency waveforms; a thermo-galvanometer to measure very low currents; and a magnetic standard, the better to calibrate ballistic galvanometers of the era. Modified versions of his thermo-galvanometer are still used today.

In 1899, Duddell decided to tackle the humming problem in London streetlights. A few years earlier, a German scientist named Dr. Simon had noticed that an electric arc could "sing" if one modulated the voltage to its power source. It is unclear whether Duddell knew of Simon's work, but he conducted numerous experiments of his own. He also discovered that varying the voltage powering the lamps allowed him to control the audio frequencies via a resonating circuit. This did not eliminate the humming problem he had set out to solve, but it did give Duddell an idea. By attaching a makeshift keyboard, he was able to produce musical notes. This led to his invention of the "singing arc," which he first exhibited to a group of electrical engineers in 1899. *Nature* reported on the invention in 1900.

It was not the first such electric instrument. Back in 1761, a Parisian inventor named J.B. Delaborde built an electronic harpsichord. There was also a musical telegraph from 1876 and an electromechanical piano from 1867. The availability of components like solenoids and motors led to many versions of electromechanical instruments. However, the "singing arc" was the first electronic instrument that could be heard without an amplifier. And those who witnessed Duddell's demonstration of his invention noticed another peculiar effect: nearby arc lamps that used the same power source also played the "music" being generated by the singing arc.

But despite the fact that he toured the country demonstrating his invention, Duddell's "singing arc" amounted to little more than an amusing novelty of engineering. He never developed it further, or patented his invention, which is a shame, because several scientists speculated about the potential for playing music over London's lighting network, based on that unusual effect. Later inventors realized that the device could be used as a radio transmitter just by attaching an antenna.

The other major electric instrument that appeared around the same time was the Telharmonium. It was patented in 1897 and built in 1906 by Thaddeus Cahill. The Telharmonium relied upon an array of 145 large rotary generators (dynamos) to create alternating currents at different audio frequencies, and then used acoustic horns and telephone receivers to convert those waveforms into sound. He even managed to construct a network of wires so that people in New York City could subscribe to his Telharmonic transmissions. The instrument was far too bulky to enjoy widespread use–it weighed 200 tons and was 60 feet long, easily filling a room, and cost $200,000 to build–but even though the prototype has been lost, it is recognized as a precursor to such instruments as electronic organs, synthesizers and similar technologies commonly used today.

Duddell went on to serve as president of the Institute of Electrical Engineers, and was elected to the Royal Society in 1907. In his later years he took on secret research for the US government. Alas, Duddell died young, at the age of 45. England's Institute of Physics named its Duddell Medal in his honor, awarded to scientists who have made contributions to the advancement of the knowledge of physics. And electric instruments revolutionized the music industry. Today, modern music makers are hearkening back to the past, creating music with "singing Tesla coils" and similar technologies. Duddell would have approved.

APS NEWS

Series II, Vol. 19, No. 11
December 2010
© 2010 The American Physical Society
Coden: ANWSEN ISSN: 1058-8132

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APS News (ISSN: 1058-8132) is published 11X yearly, monthly, except the August/September issue, by the American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, (301) 209-3200. It contains news of the Society and of its Divisions, Topical Groups, Sections, and Forums; advance information on meetings of the Society; and reports to the Society by its committees and task forces, as well as opinions.

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding *APS News* should be directed to: Editor, APS News, One Physics Ellipse, College Park, MD 20740-3844, E-mail: letters@aps.org.

Subscriptions: APS News is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $15. Nonmembers: Subscription rates are available at http://librarians.aps.org/institutional.html.

Subscription orders, renewals and address changes should be addressed as follows: For APS Members–Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org.
For Nonmembers–Circulation and Fulfillment Division, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication. Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Budget and Authorization Environment

Appropriations Update

As had been anticipated, just before the end of Fiscal Year 2010, Congress passed a Continuing Resolution (CR), and the President immediately signed it into law. The CR extended funding for federal programs through December 3rd at Fiscal Year (FY) 2010 levels with no waivers. Congress is expected to return for a lame duck session beginning on November 17th, during which the House and Senate will try to come to agreement on an Omnibus spending bill for FY 2011. However, having made major gains on Election Day, Republicans are likely to balk at passing any bill that appropriates funds in excess of FY 2008 levels. Since Senate Democrats will lack sufficient votes to break a Republican filibuster, a CR extending through the middle of February or the entire fiscal year is a very possible outcome.

When the 112th Congress is sworn in on January 3, 2011, Republicans will again make a strong effort to roll spending back to FY 2008 levels. Should they succeed, President Obama will almost certainly veto the legislation, setting the stage for a series of government shutdowns. A yearlong CR may be the ultimate outcome. A highly polarized Congress could produce an extension of that scenario through the 2012 elections.

America COMPETES Reauthorization

Reauthorization of America COMPETES remains in limbo, as the Senate version of the bill, S. 3605, has yet to reach the Senate floor, and Republican support has yet to be secured. The last action on S. 3605 occurred on July 22th, when the Senate Committee on Commerce, Science and Transportation marked up its portion of the bill that covers NSF and NIST. Since then, the Senate Committees on Energy and Natural Resources and Health, Education, Labor and Pensions (HELP) have added their sections. Two speed bumps exist. First, Commerce Committee Ranking Member Senator Kay Bailey Hutchison (R-TX) remains concerned about some of the new programs added to the bill, including an initiative on nanotechnology. Second, reauthorization of NASA occupied much of the Commerce Committee's staff time, delaying completion of report language until recently. Both make consideration of the bill problematic during the lame-duck session.

Be sure to check the APS Washington Office's Blog, Physics Frontline (http://physicsfrontline.aps.org/), for the latest news on the FY11 Budget.

ISSUE: POPA Reports

The Energy Critical Elements Study Group, which is examining the scarcity of critical elements for new energy technologies, continues work on a report that focuses on policy recommendations on a very timely issue. A final draft is due for external review in December. A recently released report produced by MITei (the *MIT Energy Initiative*), a direct result of the Study Group's first workshop, provides valuable background information on the issue. http://web.mit.edu/miteicomm/web/reports/critical_elements/CritElem_Report_Final.pdf.

The Electric Grid Study Group, which has examined the technical challenges and priorities for increasing the amount of renewable electricity on the grid, released its final report at a National Press Club news conference in Washington, DC on November 16th. An electronic copy of the report can be found on the APS website: http://www.aps.org/policy/reports/popa-reports/upload/integratingelec.pdf. See page 8 for a Back Page article om this topic.

If you have suggestions for a POPA study, please send in your ideas electronically. http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm.

Two draft APS statements have been approved by POPA. The first, a statement on healing energy, was suggested by the APS Division of Biological Physics. The statement calls into question the credibility of claims made by the alternative medicine community regarding the creation of "healing energy." The second, a statement on the misuse of quantum mechanics, was brought to the panel by the POPA Physics & the Public Subcommittee. It focuses on the improper use of the principles of quantum mechanics to validate unsubstantiated self-help programs. If approved by the APS Executive Board the draft statements will go to APS membership for comment.

ISSUE: Media Update

USA Today published a September 24th story about the reaction of the newly released report, *Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5*, and reporter Dan Vergano included a statement by the Task Force on American Innovation calling for the reauthorization of the America COMPETES bill. APS is a founding member of the Task Force and participates in its lobbying efforts to increase basic research funding.

See the APS Public Affairs website (http://www.aps.org/public_affairs) for more information.

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Ferguson said in order to appeal to more of a teenage audience she was in part inspired by the look of the popular social networking site Facebook.

"We're moving away from elementary to a 6-7-8 grade audience," Ferguson said. "Elementary needs color; this age group needs information."

Moving the audience's focus towards the information on the site was a major aim of the redesign.

We're just trying to better engage teenagers who are interested in physics," said webmaster Sara Conners. "We made the content more accessible on the main page."

In addition to a new look, Owen said that there will be a regular schedule for updates to the site's content. Mondays will feature a new video; Wednesdays, a new podcast; and every other Tuesday, a new Physics at home article about experiments people can do at home.

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shop can sign up when registering for the meeting. The deadline to register for the meeting is January 14.

At the APS Prizes and Awards Ceremony on Monday evening, awards will be presented to physicists who have made outstanding contributions to their fields. After the awards are given, the prize ceremony segues directly into the meeting's welcome reception where attendees can mingle and enjoy refreshments.

Following the evening's welcome reception, Barbara Jones of Penn State University will host a special physics community outreach session about how to make science appealing to children. Her talk titled, "Small Wonders: Bringing Nano to the Public Through Museum Partnership" will discuss ways that academic institutions and museums can partner together to excite and interest kids in the growing field of nanotechnology.

Tuesday evening, the divisions of Chemical Physics, Computational Physics, Condensed Matter Physics, and Materials Physics will host a reception at the Hyatt Reunion Hotel, honoring their newly named fellows and award winners. Also on Tuesday evening is the student reception organized by the APS and Forum on Graduate Student Affairs.

At the meeting, students may sign up for Wednesday afternoon's Lunch with the Experts. There, graduate students will be able to lunch with an expert on a topic of their choice and participate in informal, freewheeling conversation.

APS and the Society of Physics Students have teamed up to put on several events for undergraduates. There will be student oral and poster sessions, awards, and a "design your own t-shirt" contest complete with prizes. For the career-minded undergraduate, panels on careers and graduate schools will be held. Travel grants of up to $1,000 are available to students presenting contributed papers at the meeting.

As many as 130 exhibitors will have booths in the exhibit hall, representing everything from laboratory equipment and software to book publishers and education suppliers. The exhibit hall will be open from 10 a.m. through 5 p.m. Monday and Tuesday, and from 10 a.m. to 4 p.m. on Wednesday. Wine and cheese will be served on Monday and Tuesday from 4 to 5 p.m.

As always, at APS's Contact Congress booth, attendees are invited at any time to send a letter to their member of Congress about the importance of federal research funding.

In Command, on the Front Lines of Radiation Research

By Alaina G. Levine

If you are traveling through the airport and happen to be standing next to Colonel Mark Melanson while he is in uniform, you will know right away that he is in the Army; however, that would hardly begin to tell the whole story. Colonel Melanson is also a physicist, world renowned expert in the medical effects of radiation, and the senior health physicist in the United States Army (Health physicists are experts in radiation safety.). As the 16th Director of the Armed Forces Radiobiology Research Institute (AFRRI), Melanson leads a team of 200 personnel, including medical officers and civilian research scientists, to ensure the safety of US soldiers and those they protect from the harmful effects of radiation exposure. He is only the fourth physicist to hold the top position at AFRRI, considered "one of the premier radiation effects research laboratories in the world," he says.

The Institute, celebrating its golden jubilee this year, is charged with studying the biological effects of ionizing radiation and developing medical countermeasures to protect against its lethality. In addition, it provides medical training and emergency response teams to manage incidents related to radiation exposure, according to its website.

The Colonel received his bachelor's degree in physics from Dickinson College in Carlisle, Pennsylvania, where he was an Army ROTC scholarship recipient. When he graduated in 1983, he was commissioned as a second lieutenant, nuclear medical science officer. He later acquired his master's and PhD in radiation health sciences from The Johns Hopkins University. During his more than 27-year career, he has held a variety of positions in health physics in the military, including his previous assignment as chief of Health Physics at Walter Reed Army Medical Center and leader of the elite US Army Radiological Advisory Medical Team.

"I have experienced the whole spectrum of the health physics profession," Melanson says, "medical, environmental cleanup. I've done everything in the field of health physics. My career has served me well."

He has also experienced war firsthand. In 2003, he was deployed to Iraq to assess the safety of soldiers at the 23,000-acre Tuwaitha Nuclear Research Center, "the crown jewel of Saddam Hussein's nuclear weapons research program," as Melanson wrote in an article for the Army Medical Department Journal (Melanson)[1].

He recounts how "I got called down to the Old Executive Office Building [now renamed the Eisenhower Executive Office Building] in Washington, D.C., in the early phases of Operation Iraqi Freedom, because the White House was concerned about the safety of US troops." When asked about the safety of American men and

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Letters

Petition Process Fraught with Irregularities

The October article titled "Plans Afoot for Topical Group On the Physics of Climate" refers to APS President Callan having "commented that he hoped this TG would go a long way toward reducing tensions that had been raised within the society by the climate issue…"

Within the APS, founded as it was for the advancement and diffusion of knowledge, these tensions can hardly be alleviated without first being disclosed and openly discussed. As our petition group sees it, there is basic disagreement concerning important aspects of the scientific process. In normal practice, the APS facilitates communication, which is carried out by individual scientists and collaborating research teams. For any topic, and during any particular period of time, published results and less formal communications either agree or don't agree with one another, understanding either converges or fails to converge, and consensus is either reached or not reached. Although many mechanisms exist for encouraging justified consensus, science can progress only when assent is voluntary and based on evidence, as understood by individual scientists. We view the leadership posture, exemplified by the APS Statement on Climate Change, as conflicting with this voluntary, evidence-based process by imposing an institutional position on a scientific question.

The TG Petition disseminated by Roger Cohen aimed to bypass this conflicting barrier by establishing an APS Unit having the following five characteristics: (1) focused on the physics of climate; (2) open to all scientific communication falling within the scope of its Areas of Interest (AoI) statement; (3) not subject to any constraint associated with the APS Statement on Climate Change or any other institutional position; (4) open to AoI modification based on progress in climate physics; (5) excluding separate and potentially distracting topics such as policy and the environment. The open character of this petition was affirmed by the composition of its signatory group, which includes both supporters and opponents of the APS Statement on Climate Change.

The TG petition effort was conducted in accordance with Article VIII, Section 1 of the APS Constitution, under which two hundred or more APS members may petition the Council to establish a TG. Two documents are required for the TG to be considered and established: an AoI statement and Bylaws. The petition, with our AoI statement and a list of 225 signatories, was submitted on 4 August 2010. Our draft Bylaws document was submitted the next day. On the basis of both the APS Constitution and precedent, we had every reason to expect this petition to be taken up by the APS Council at its November 2010 meeting.

In conflict with this reasonable expectation, the APS leadership acted so as to produce an entirely different result, the establishment of a leadership-selected Organizing Committee (OC). This body is mentioned nowhere in the APS Constitution. Moreover, contrary to the October article, the initial OC meeting is scheduled to occur after the November Council session, thereby insuring that TG approval cannot occur under the normal process prior to April 2011. There are additional irregularities, including these:

1. Competing Initiative. On 2 August 2010, as our Petition was about to reach its minimum goal of 200 signatures, APS President Curtis Callan disseminated a competing initiative titled "Topical Group on the Physics of Climate and the Environment."

2. Petition Confusion. Although President Callan's message contained no AoI statement, and is not clearly and unambiguously recognizable as a petition as defined in the APS Constitution, the APS leadership has chosen to treat it as a petition. In addition to lacking an AoI statement, it refers to itself as a "solicitation of support," contains phrases indicative of a survey such as "…see whether you would be interested," and is described in the October issue of *APS News* as having been authorized by Council as a "poll [of] the membership."

3. Misleading Claim of Support. It is misleading to assert that 800 members believe that they signed a distinct and separate petition, because some APS members inquired of our group as to whether or not the message they received was in some way related to or supplementary to our own Petition.

4. No Authoritative Evidence of Authorization. The October article refers to Council authorization for a poll of the membership given in April, but the Minutes of this Council meeting showed no such authorization when accessed on 3 October 2010.

5. Disappearing Rationale. The substantive elements in President Callan's initiative that made it different from our Petition, the topics of environment and policy, were soon dropped by the APS leadership, thereby removing the only seemingly legitimate purpose for convening an OC that has the reconciliation of conflicting petitions as its primary responsibility.

Roger Cohen's participation in the OC, in spite of these discouraging irregularities and an unnecessary delay, reflects the possibility that the OC might nevertheless eventually result in establishing a TG consistent with our group's goal of open and unconstrained scientific communication. The actual outcome, and the possibility of reduced tension, will depend on actions taken by the APS leadership and the OC members it selected. Additional information about our group's Petition effort can be accessed at http://climatephysicspetition.wordpress.com/ .

Robert Levine
Sierra Vista, AZ

Early Work on Graphene Cited

In response to an article entitled "October 22, 2004: Discovery of Graphene" Andre Geim wrote a letter to *APS News* to express his opinion that "One needs to be aware of many earlier papers that poked in the same direction. Researchers previously tried to make increasingly thinner sheets of graphite and grew thin graphitic layers on top of other crystals. Their papers were mostly–if not entirely–observational, and there was no convincing case put forward to spark the graphene gold rush."

There is no doubt that Geim and Novoselov made a significant contribution to graphene physics by observing, in late 2004, that electron mobility in graphene is 100 times faster than that in silicon [1]. However, Geim did not cite patent literature and conference proceeding papers where significant discoveries and technology developments had already been reported. After 2004, a large percentage of academic and popular literature attributes the discovery of graphene to Geim and Novoselov.

I am writing to offer my observations on this issue. Based on our open literature and patent document search results, there does not appear to be any report before 2002 that convincingly documented the actual production and use of free-standing single-layer graphene sheets for any application. However, significant work had been done in graphene between 2002 and 2004, briefly summarized below:

In 2002, Jang et al. produced single-layer and multi-layer graphene by carbonizing polyacrylonitrile (PAN) fibers, partially graphitizing the resulting carbon fibers to produce graphene sheets dispersed in an essentially amorphous carbon matrix, and then extracting/ isolating these graphene sheets out of the amorphous carbon matrix.[2]

Jang, et al. also investigated these graphene sheets as a reinforcement for various composite matrices and developed several methods of producing graphene in large quantities.[2,3] In March 2004 (seven months prior to Geim's paper), Schwalm, Schwalm, Wagner and Jang presented a paper at the APS March Meeting in Montréal that discussed the density of states and related electronic properties of graphene.[4]

In 2003, Kaner's research group at UCLA reported potassium-intercalated and exfoliated graphite sheets.[5] In 2004, Walt de Heer's research group at Georgia Tech reported thin graphitic layers grown on SiC as a base material for future integrated circuits.[6] I am of the opinion that single-layer graphene was produced in both cases.

Bor Z. Jang
Dayton, OH

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Headline Creates False Impression

The story "Two Women Chosen as Blewett Scholarship Recipients" in the October *APS News* caught my eye.

Although I was aware that there existed a scholarship program to help female physicists return to research careers, I didn't remember its name. So, from just the title of the article, APS seems to be saying, "WOW, two women actually won something, isn't that unusual!" Scanning the article informed me of the nature of the scholarship, making the mention of the recipients' gender in the title completely unnecessary.

Pointing out that a woman won a prize leads to reactions ranging from believing the woman only got the award because of her gender to perhaps APS feels an incessant need to point out that there are in fact female physicists. Although the field is growing more welcoming to women, constantly having your achievements questioned or having colleagues continually feel the need to point at you and say 'look, a woman!' is tiring and demeaning.

Simply titling the article "Drichko and Nikolic-Jaric Chosen as Blewett Scholarship Recipients" or "Blewett Scholarship Recipients Chosen" would have sufficed.

Jennifer Steele
San Antonio, TX

Physics Degree Has More Than Economic Value

I would like to add two points to Jean George's letter in the October 2010 *APS News*.

First, I think the ideas of a "pre-physics" degree is interesting, though I'm not sure physics is similar enough to medicine for an equivalent approach. Premed students have more than one possible major that can prepare them for medical school, with different majors preparing students in different ways, all useful. At least some premed curricula can themselves directly prepare students for jobs in the medical field, though not for jobs as physicians or surgeons. But whether or not a degree advertised as "pre-physics" is a good way to clarify job prospects to potential students, they do need to know what they can and cannot do with just a baccalaureate background in physics.

Second and more importantly, I think the approach implicit in George's recommendations–to avoid job dissatisfaction problems by physicists with graduate degrees by not actively recruiting people to graduate study in physics–is a very good one if not taken too far, i.e. by limiting the admission rate of new physics students based on job prospects for the field instead of school capacity. Like George and many others of us, I'm not working in academia these days either, so if my interest in getting a degree were job satisfaction as a physicist I would have been better off not bothering with a graduate physics degree at all. But that wasn't why I went to graduate school. Sure, I wanted the opportunity for a research career. But more than that, I got the education I did (through considerable hardship) because I didn't want to not understand the universe any more than I could help. To me, not becoming a physicist would have been like being blind and remaining so when it wasn't necessary. Even if my eyesight were of no help in making a living, or if I could get rich by not seeing. I wouldn't give up vision. Same with physics.

The solution is in part, as George suggests, to avoid recruiting people into physics if they wouldn't take it up on their own; but we should also avoid shutting people out of a physics education "for their own good" just because the prospects of a livelihood may happen to be bleak. Anyone who wants to understand nature regardless of job prospects (I think this includes a lot of the APS membership) would be well served by (1) the clear understanding of physics that they come to school to gain, (2) a clear understanding of the field's job prospects, and (3) a knowledge of how to make a worthwhile living either way, whether in physics as the opportunity exists, or in other work otherwise. And to ensure that this happens, physics faculty also need to figure out how to make their own way in the world when the market doesn't (or shouldn't) favor recruiting students who really would be happier elsewhere.

William N. Watson,
Oak Ridge, TN

Physicist Loses Congressional Race in Arizona

By Alaina G. Levine

If it really does take a rocket scientist to fix our problems in the federal government, Arizona voters may not agree. In the race in Arizona's 7th Congressional District between incumbent Democrat Raúl M. Grijalva, and Republican Ruth McClung, the unofficial tally was clearly in favor of Grijalva. There were 78,419, or 50.04%, of the votes cast for the Co-Chair of the Congressional Progressive Caucus, vs. 69,386, or 44.27%, for McClung, who works as a physicist for a government contractor. The outcome is almost certain, although at press time some ballots were still being counted.

McClung, who had never run for office before this race, found the experience eye-opening. "It's very different from science and engineering," she said. "2 plus 2 no longer equal 4" Surprises included the number of lawsuits that are filed against candidates. Although McClung said she was never sued personally, she did receive "cease and desist orders" and had to hire an attorney.

But she was encouraged by speaking with people on the trail, and by the response she received from the scientific community. "Most people were excited that someone with a science background would run for political office," she said. The President of the American Institute of Aeronautics and Astronautics (AIAA) contacted McClung to express support, and the Arizona Technology Council (ATC), a private, nonprofit trade and advocacy association, supported her campaign. "I was the first federal candidate that they had ever endorsed," McClung noted. Steven G. Zylstra, President and CEO of ATC, characterized this decision as opportunistic. "She represented the kind of candidate who would represent the technology industry in Congress," he said. "She's a physicist, works for Raytheon, and understands the unique challenges of this industry. And it looked like she actually had a chance [to win] so it was a good time to weigh in on that campaign."

McClung was pleased that "many people saw my science background as a plus." Responding to questions from the public "was hard sometimes because people often want a 'yes' or 'no' answer, but often I had to give more nuanced answers because unless you know all the variables, many things can be more gray," she explained.

"Running for office was a rewarding experience," she concluded. "It may not be for everyone, but we need a good representative government and people with a science background certainly can offer a great deal to help our country… I can see myself running again. It was extremely hard at times, but if you don't get involved, you can't make a difference."

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Laser's 50th Birthday Sparks Yearlong Outreach Effort

As 2010 draws to a close, so too does LaserFest, the celebration of the fiftieth anniversary of the first working laser. The yearlong collection of events brought attention not only to the laser itself, but the scientific research and development that led to its invention and applications.

"LaserFest was a year's worth of outreach events all around the world related to the laser's birthday," said James Roche, APS LaserFest Coordinator, adding that the aim was to give the public "a better appreciation about how your everyday life can be improved by scientific innovation like the laser."

APS joined with three other founding partners, the Optical Society of America, IEEE Photonics, and SPIE, to make LaserFest happen. By the end of the year, a total of 76 additional partners had signed on as well.

LaserFest held a gala kickoff event on February 12 at the Smithsonian National Museum of American History, on the heels of the worst blizzards Washington DC had seen in years. An auditorium full of hardy souls who braved the elements heard Energy Secretary Steven Chu, who shared the 1997 Nobel Prize in physics for a technique to cool atoms with lasers, deliver the keynote talk.

The laser officially celebrated its birthday on May 16, marking fifty years to the day after Theodore Maiman demonstrated a working laser for the first time. OSA held a symposium at the CLEO conference in San Jose, and APS dedicated a commemorative plaque at the Hughes Research Laboratories in Malibu, California, at the site where the historic event occurred.

Additionally, that week the US House of Representatives drafted a resolution honoring the laser, and President Obama issued an official White House letter lauding the basic science research that led to the laser's invention.

"One of the biggest successes of LaserFest is that it's an unprecedented collaboration and cooperation, a partnership of a lot of scientific organizations that haven't ever really done this before," said Barbara Hutchison, director of global development at OSA"

The LaserFest website served as an interactive nucleus for users to find information about the laser, LaserFest and associated events. Because of its wealth of information, organizers plan to keep it active past the end of the year so the public can still access information on the laser including the latest laser news, a detailed timeline of the conception, invention and applications of the laser, information on how lasers work, and what everyday items they are part of.

With funding from the Department of Energy, the National Science Foundation and the Richard Lounsbery Foundation, APS sponsored LaserFest on the Road to recruit people enthusiastic about outreach to help spread the word about science and lasers. Almost 100 applicants submitted their own original ideas for outreach events and activities. All told, 38 teams received grants to disseminate the message of LaserFest across the country and internationally.

David Scherer of Physical Sciences Inc. traveled to classrooms in Guatemala City and Antigua, Guatemala with an activity module for students to learn hands on about how lasers and optics work. Students at Idaho State University put on a travelling laser science road show that went on tour across Idaho and Nevada putting on free laser demonstrations. Eight students from the Laser Research Institute at the University of Stellenbosch in South Africa travelled 5500 kilometers visiting nine remote rural schools across South Africa and Namibia bringing laser and optics demonstrations to school children, many of whom had never seen a laser before.

Members of the APS outreach team traveled across the country and even across the Atlantic to participate in different events and meetings informing people about how society has been affected by lasers. In addition to various APS meetings, as well as meetings of the American Association of Physics Teachers, some of the locations included Germany's LASYS conference, the American Geophysical Union conference in San Francisco,

Photo by Michael Lucibella

LaserFest was a major participant in the USA Science and Engineering Festival, which attracted an estimated half-million visitors to the Mall in Washington over the weekend of October 23-24. Working with the Society of Physics Students, the American Institute of Physics, the American Association of Physics Teachers, and OSA, APS created the "Laser Haunted House" with several laser demos embedded in a Hallowe'en-themed setting. Thousands waited patiently for their chance to see and play with the lasers inside. In the photo, APS LaserFest Coordinator James Roche demonstrates the "squealing wall", in which a laser beam, reflected off a mirror and coupled to a solar cell and speaker, produces eerie sounds due to the interference of the beam with itself.

BIRTHDAY continued on page 8

INTERNATIONAL News

...from the APS Office of International Affairs

Renewable energy research in Norway

By Jon Samseth

Norway is unique in terms of electricity production. Almost 100% is provided by hydroelectricity. A growing population and increased consumption demand new electricity generation capacity in addition to extending the electricity distribution grid both internally as well as to other nations, primarily to Sweden, Denmark, Germany and the Netherlands.

Grid extensions are important for balancing the electricity generation between the different producers and for having a more secure supply. However, it does not add to the overall production capacity. Since 1995 essentially no significant new electricity power generation capacity has been added, although a couple of gas-fired power plants have been constructed. For a period the price of natural gas was too high to make them economically profitable so they were standing idle. After the introduction of shale gas, the price of gas has come down and they are providing electricity to the grid.

The Norwegian government has engaged in developing new renewable energy production and new, large scale technologies for CO_2 capture. The initiatives are at several levels; direct support for new generation capacity like wind energy, adding of thermal energy production based on biomass and solid municipal waste in order to replace heating using electricity and oil, and supporting research into renewables and CO_2 capture.

The research takes place at the major Norwegian universities and research institutes. The latter are independent, non-profit organizations, which have to generate the majority of their income from contract research either with industry and/or the Norwegian research council. During the last decades EU funding through different framework programs constituted a significant source for several institutes.

In 2009, after a peer review process, eight Centers for Environment-friendly Energy Research (CEER) were established. These centers get significant base funding from the research council, but they are also expected to find additional funding for their research.

The objective for these Centers for Environment-friendly Energy Research is to focus the research within a selected field. It is expected that the research will have a high scientific merit and also include collaboration with foreign research groups, thus fostering the possibility of achieving significant advances in the selected field. Each center is planned to last for an eight year period.

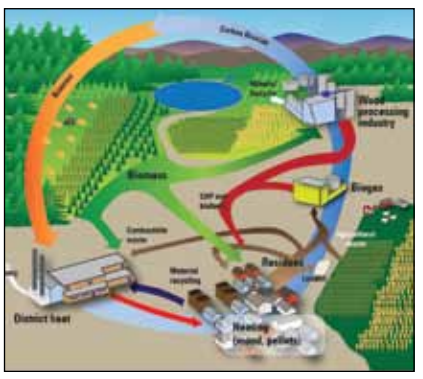

Illustration: SINTEF

A schematic view of energy generation from the Bioenergy Innovation Center.

The final selection yielded two centers for offshore wind energy, two centers for CO_2 capture and storage, one center for bioenergy, one center for solar energy, one center for zero emission buildings, and finally one center for renewable energy systems where hydroelectric power constitutes a major component.

The two centers on offshore wind energy, NORCOWE and NOWITECH, complement each other, and together they cover studies of wind and ocean conditions, new offshore wind technology as well as deployment and operation of wind energy farms.

Norway is often referred to as a country with expertise in CO_2 capture and storage (CCS). This is due to the experience with the Sleipner offshore gas field where CO_2 is separated from the produced gas and reinjected into the reservoir. It is therefore no surprise that among the eight centers two of them, BIGCCS and SUCCESS, will be working on CCS. These centers cover the value chain from CO_2 capture from power generation, transport of CO_2 and CO_2 storage.

The metallurgical industry has been strong in Norway since the introduction of hydroelectric power. This tradition and competence has been used to produce solar cell grade silicon and has made Norway a significant player in that field. The Norwegian Research Center for Solar Cell Technology continues this tradition and aims at further developing mono- and multi-crystalline silicon solar technology, including processes for silicon crystallization.

Based on solid biomass, the Bioenergy Innovation Center (CenBio), looks at the biomass supply, logistics in harvesting and utilization, and conversion technologies in addition to heat and possibly electricity generation. The use of biomass for district heating is common throughout Scandinavia.

Besides these centers, there are also research and development activities on other forms of renewable energy technologies. The national power utility, Statkraft, has built an osmotic power pilot plant. It has however, a long way to go before this technology is even close to getting into the market.

Closer to being commercialized, but still into the future, are tidal power plants. They are essentially submerged wind turbines that generate power from strong tidal currents.

Last, but not least, are the initiatives on generating power from ocean wave action. Several concepts are being considered.

Jon Samseth is a professor of physics affiliated with SINTEF, NTNU (Norwegian University of Science and Technology) and Akershus University College. He is the current vice president of SCOPE and has served on the IUPAP energy working group and is member of the EPS energy group.

FUNDING continued from page 1

search while Democrats favor energy and environmental research. Active support for science research generally comes from those representing individual districts that have large research facilities such as major universities, a high tech industry, or a government lab.

"I don't think you can say one party or the other is stronger, it depends on the personalities and the leadership. In the case of John Boehner, I don't think he is [particularly strong on science]," said Michael Lubell, director of public affairs of the American Physical Society. Lubell added that "the biggest loss as far as I'm concerned is Vern Ehlers," referring to the former physicist and long time Republican congressman from Michigan who retired before the elections (see photo in the October *APS News* (available online).

Representative and physicist Bill Foster (D-IL) lost his seat in November's election, while physicist Rush Holt (D-NJ) narrowly retained his.

Experts expressed concern that many of the freshmen congressmen ran on the platform of shrinking government spending, and science funding is often an easy target for cuts.

Initial fears that a 2011 budget wouldn't be passed before the next congress have been somewhat allayed as the Democratic leadership has pledged to push through next year's budget during the lame duck session. Without a budget, federal agencies could be funded through a continuing resolution that would keep most funding at 2010 levels, effectively shrinking the budget because of inflation.

"It's really unclear right now. The Republicans came to power on the platform of budget cuts, but it looks like it won't happen in 2011," said Clemins.

President Obama reiterated in a speech the day after the November elections that funding for science research and education are top priorities and he would resist cuts in those areas. The president's budget request for 2011 includes modest increases to science research funding in various federal research departments. The House and Senate versions generally mirror the president's requests for increases except in the Department of Energy's Office of Science, where the House version zeroes out the increase, and the senate cuts the requested 3.3 percent increase to 1.5 percent.

However storm clouds for science and science funding may be gathering on the horizon, warn experts.

"During the campaign the presumed Speaker of the House [Boehner] was very adamant on rolling back spending," said APS advocacy coordinator and science education specialist Kris Larsen. He added that, in August, Boehner campaigned on cutting government spending to 2008 levels. This would mean a significant cut to science research, which has enjoyed an additional boost in the past two years.

Before the election the president sent out a memo to non-defense related agencies calling on them to cut their budget requests by at least 5 percent in 2012.

"Discretionary funding is going to take a hit. It's going to get cut across the board is my guess," Larsen said, "My guess is that the NIH will be a little more insulated than the basic physical sciences. I think physics is definitely going to be in trouble. Anything related to earth science, anything painted with climate change is going to face difficulties."

Like much in Congress, the support of science funding has become more polarized in recent years. Earlier this year the debate over the America COMPETES Act, which authorizes funding for science and technology research, turned strongly partisan, with nearly all Republicans voting against it, despite bipartisan support in 2007. During the debate, presumptive chair of the House science and technology committee Ralph Hall (R-Texas) attempted to scuttle the legislation by inserting a "poison pill" amendment calling for the firing of federal research employees that look at pornography at work.

"Ralph Hall has been a relatively good supporter in the past," said Larsen, "[but] he didn't come through this year with the COMPETES vote."

Should the subject of science funding continue to become more partisan, Lubell warns that the House science and technology committee could also shift its focus towards investigation and oversight of past science funding.

"The real activity in the House is going to be on oversight, at least as far as science is concerned," said Lubell, predicting that the science and technology committee will likely hold "a series of hearings questioning the use of federal funds, and calling for justification for the support of science that doesn't have a specific relevance other than knowledge."

RADIATION continued from page 3

women guarding the bombed, looted, and burned nuclear complex, he replied, "I can't answer that without my boots on the ground and [the ability to] take radiation measurements and collect environmental samples." Before he knew it, Melanson was deployed into the middle of the war zone.

He and his team delicately maneuvered around gunfire to get to the large nuclear complex where they took air and soil samples and used radiation detection instruments to assess any exposure risk for the approximately 4000 American soldiers and marines operating at or near the complex, which was located 20 kilometers south of Baghdad.

"It's very sobering" being in war, he notes. Extreme danger was omnipresent. "You always had that in the back of your mind. The threat of getting wounded or killed was always there. While you're trying to get your job done, you always know you are in a war zone." He was in Iraq for nearly two weeks and collected thousands of radiation measurements and hundreds of environmental samples. While Melanson's team ultimately determined that the site had minor radiological contamination, the levels were deemed to be safe. "I am most proud of this mission to Iraq," he says. "Potentially there were lots of soldiers in harm's way and I was the only one who could say if they were safe or not."

Throughout his career, the Colonel has successfully balanced the demands of being both an officer and a scientist. "On the officer side," explains Melanson, "you are expected to be a leader and have an understanding of how the Army works." As a military health physicist, you must know how to support operational missions and ensure protection against radiation's harmful effects. The Army's Nuclear Medical Science Officer career field, which Melanson leads as a consultant and career field manager, traces its proud heritage directly back to the Manhattan Project, he explains. Of course, maintaining superior levels of skill in physical fitness, military strategy, and weapon qualification are a given.

In addition to leading AFRRI and the Nuclear Medical Science Officer career field, Melanson publishes papers, speaks at scientific meetings, and serves as an assistant professor in the Department of Preventive Medicine and Biometrics at the Uniformed Services University of the Health Sciences, located in Bethesda, Maryland, where he teaches health physics, health risk communication and radiobiology.

"First and foremost, I am an Army officer," he says, "although the Army and science are equally important in my mind; I never felt I had to trade off one for the other." To be sure, Melanson does not believe that Army and health physics professionalism are in conflict. "On the contrary, they are complementary," he argues. "As a [health physicist], your duty is to protect people from radiation; [and] as an Army officer, I do that for our troops."

Colonel Mark Melanson briefs soldiers at the Tuwaitha Nuclear Research Center in Iraq in 2003 about the radiation risks that they face.

In fact, "as the Army's expert in radiation, the senior leadership in the Army turns to me to provide my unique expertise on how to reduce radiological exposure and risks," he continues. "They ask for my professional judgment based on the science. I'm not pressured to say anything other than the scientific truth."

One of the truths that Melanson strives to impart to the public is that AFRRI's investigations are nonoffensive. "First and foremost, we're focused on protecting people from radiation effects. We're not developing better ways to kill people with radiation," he passionately declares. This research has useful applications beyond the borders of the military, he says, such as in medicine, and is often integrated with scientific research conducted by other countries.

Still in his first year at the helm of AFRRI, Melanson is focused on a number of what he calls "grand challenges." He wants to orchestrate better, more prepared medical response teams in the event of a dirty bomb or nuclear detonation on American soil. His Institute is researching more sensitive methods of biodosimetry, laboratory results or clinical observations that determine a person's radiation dose. His team is pursuing faster, more sensitive, longer-lasting biodosimetry tools that could be used "before or after [a] nuclear detonation to reduce mortality and sickness," he describes. Furthermore, AFRRI scientists are examining avenues to "administer countermeasures to reduce the lethal effects of radiation."

The Colonel trumpets the multitude and diversity of health physics careers in the Army; Melanson's path has been a "rewarding" one, he acknowledges.

"My primary interest in getting involved with APS [the American Physical Society] to do this interview was not to satisfy my own ego of being in print, although my mom will like to read the article, I won't deny this," he says. "It was to show physicists and graduating physics majors that there are exciting and rewarding opportunities for health physicists while serving in the Army."

There are approximately 60 uniformed health physicists in the Army serving around the globe. Each year the Army is looking for several new recruits to join the career field. Physicists with bachelors, masters, or doctoral degrees are all qualified to enter the Army as nuclear medical science officers. Their pay is dependent upon their degree and any experience they may have in radiation safety. Once on active duty, these officers receive military and health physics training, and practice the craft of health physics, and are eligible to compete for graduate school fellowships where they can shed their uniforms and go to grad school for free while earning their full pay and allowances. After 20 years, nuclear medical science officers can retire and receive half of their pay, adjusted for inflation, for the rest of their lives. Many of these retiring officers go on to start second careers in radiation safety while others completely retire and enjoy their hobbies full time. Physicists or graduating physics majors interested in finding out more information are encouraged to contact Colonel Melanson at (301)-295-1210 or via his official email address: mark.melanson@us.army.mil.

[1] Melanson, MA, et al. Assessing and communicating deployment radiation risks in Iraq. *U.S. Army Medical Department Journal.* January-March 2004; p 39-43.

Alaina G. Levine is a science writer and president of Quantum Success Solutions, a leadership and professional development consulting enterprise. She can be contacted through www.alainalevine.com.

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WEBINAR continued from page 2

around 50 participants.

"The biggest advantages of the webinar format are convenience and cost," says Crystal Bailey, Education and Careers Program Manager at APS, who manages the APS webinar series. "Many people who cannot afford the time or money to travel to a meeting can get valuable information by spending an hour participating in a webinar. We're particularly looking at webinars as a means to reach students, teachers, and industrial members–groups that rarely have the time and funding for travel."

Audience members from both sessions reported very high levels of satisfaction with the presentations and format. One participant from the patent law webinar wrote, "As a postdoc, I love to see webinars from people with PhDs who transition out of academia but still make their PhD count for something."

"Another big plus for this format is the interactivity," says Bailey "Webinars allow participants from around the country or even the world to ask questions of the speaker and get them answered in nearly real time."

APS webinars were inspired by the American Chemical Society, which produces one webinar every week on a variety of career and professional development topics. Looking forward, APS plans to run webinars at least once a month, and possibly more if demand warrants. Future presentations will address issues of concern to students, such as finding a summer research experience and learning about physics careers, as well as professional development for faculty on topics such as work-life balance and salary negotiation strategies.

For more information on APS Physics Career webinars, including archived versions of previous presentations, see www.aps.org/careers/guidance/webinars

ANNOUNCEMENTS

THE AMERICAN PHYSICAL SOCIETY is currently accepting applications for the Congressional Science Fellowship Program. Fellows serve one year on the staff of a senator, representative or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows have the opportunity to lend scientific and technical expertise to public policy issues.

QUALIFICATIONS include a PhD or equivalent in physics or a closely related field, a strong interest in science and technology policy and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be U.S. citizens and members of the APS.

TERM OF APPOINTMENT is one year, beginning in September of 2011 with participation in a two week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

A STIPEND is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

APPLICATION should consist of a letter of intent of no more than 2-pages, a 2-page resume: with one additional page for publications, and three letters of reference.

See http://www.aps.org/policy/fellowships/congressional.cfm.

All application materials must be submitted online by January 14, 2011.

Reviews of Modern Physics

Recently Posted Reviews and Colloquia

Random matrices and chaos in nuclear physics: Nuclear reactions

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The connection between nuclear reactions, random matrix theory, and chaotic dynamics dates back to Bohr's theory of the compound nucleus and the statistical description of nuclear resonances by Wigner. While this review focuses on the application of random matrix theory to nuclear reactions, the discussion is extended to a generic theory of quantum chaotic scattering that pertains to mesoscopic systems. Various tests of the theory are reviewed, with close attention given to violation of symmetries (isospin, parity, and time-reversal).

http://rmp.aps.org

APS Section Meeting Briefs

- **The Texas Section of APS** held its meeting in conjunction with AAPT, Zone 13 of the Society of Physics Students and the National Society of Hispanic Physicists from October 21 through 23 at the University of Texas at San Antonio. Pedro Montano from the Office of Basic Energy Sciences in the Department of Energy delivered a talk outlining an overview of the basic energy sciences being conducted by the Department of Energy. Marilia Samara from the Southwest Research Institute talked about recent advances in low-light-level imaging technology used for observing meteors and aurora. Carlos Ordoñez, from the University of Houston, spoke on the calculation of black hole entropy, and he opted to focus on the methods and logic used to conduct his research in hopes of encouraging the graduate student members of his audience.
- **The 77th Annual Meeting of the Southeastern Section** was held from October 20 through 23 at the Baton Rouge Marriott in Baton Rouge Louisiana. The meeting featured a tour of the LIGO facility for the meeting participants as well as numerous talks from the observatory. Lisa Barsotti from LIGO and MIT delivered an update on how the current upgrade to the "Advanced LIGO detectors" should, once completed, soon yield the first detections of gravitational waves. Todd Adams from Florida State University showed the first preliminary results from the LHC's CMS experiment. Kristopher Larsen from APS's Washington office gave a preview of the changing political landscape when it comes to science funding and how physicists can get more involved with the political process.
- **The California Section of APS** met from October 29 through 30 at Caltech in Pasadena California. Several special guest speakers highlighted the meeting. Sean Carroll of Caltech spoke at the first plenary session about the origins of time and the universe. Also at the first plenary session, Josh Willis of the Jet Propulsion Laboratory delivered a talk about how global warming is affecting the oceans. Kip Thorne, also of Caltech, spoke after the Friday evening banquet about the warped nature of the universe. The second plenary session featured Tom Murphy from the University of California, San Diego describing how it's possible to test general relativity by bouncing a laser beam off the moon, and Steve Block from Stanford University spoke on how biophysics can be used in gene sequencing.

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gram we should keep."

Physics was one of six other bachelor's degrees and one masters also slated for deletion. Students already enrolled in the programs will be allowed to graduate, but the physics major will not be offered to future classes.

Physics classes won't completely disappear from the campus. While adjuncts will likely be let go, the three full time faculty members are expected to be retained to teach service courses, general education requirements, classes for the physics minor and an upcoming bachelors degree in nanoscience.

"About three years ago we developed an undergraduate degree in nanoscale science," Dunham said. "We decided we would eliminate our straight physics major and focus on our nanoscience program."

Missouri State University in Springfield, MO has also had to trim its physics offerings because of the state budget shortfalls. Though keeping its physics major, the school had to eliminate its engineering physics bachelor's degree.

"Physics is always the smallest of the sciences," said David Cornelison, head of the physics, astronomy and materials science department. "We were already going to make some changes, but we had to make some hard decisions over a short period of time."

Missouri State recently created a full engineering major and the engineering physics degree has dwindled as more students have opted to take straight engineering. No faculty are expected to be let go, and students already enrolled in the major will be allowed to finish their degree.

"We will ensure that they can graduate. There is no immediate plan to eliminate those courses," said Tamara Jahnke, dean of the College of Natural and Applied Sciences, referring to classes that current engineering physics majors need to finish their degrees. She added that she would resist any moves to cut the physics major, "I do not want to see the elimination of the whole department ever."

North Arizona State University in Flagstaff, AZ has similarly had to eliminate its engineering physics bachelor's degree along with its "physics and math" major.

"The reason that this degree is going away…is because they are under-enrolled" said Kathy Eastwood, a professor of physics and astronomy. "It's the degree that's going away, not the department. No one's lost their job yet."

Though disappointed to see the major go, Eastwood and the rest of the department opted not to fight the administration on the elimination of engineering physics. The course had not been accredited by ABET and the university had been issuing warnings that the major was under-enrolled for several years. The Arizona State Board of Education requires that a major graduate 24 students in three years, while only three students had graduated with the physics and engineering degree in that time.

However, Eastwood is gearing up for more potential budget cuts next year. "I have a horrible feeling that we're going to have fight for the next one," she said. "I will fight like hell if they try to make us get rid of physics."

APS Plasma, Nuclear, and Laser Divisions Hold Fall Meetings

Physicists from across the country gathered for the largest annual plasma physics meeting in the nation. The 52nd annual Division of Plasma Physics Meeting was held at the Hyatt Regency Chicago in downtown Chicago from November 8 through 12. The meeting highlighted the latest discoveries and breakthroughs in all plasma-related fields. Some of the most exciting work in the field is focused on understanding and mitigating focused bands of heat escaping from magnetic containment rings inside fusion reactors. These bands of extreme heat, called footprints, jet out from a fusion reaction along magnetic field lines otherwise used to contain the heat, and have so far hampered progress towards developing effective methods to fully contain the reaction. Tuesday afternoon's session focused on the continuing problems of containment by developing a deeper understanding of the counterintuitive physics governing the size of the footprints and other ways to eliminate impurities and energy oscillations in the fusion reaction. The largest fusion reactor in the solar system, the Sun, is getting some attention of its own. James Chen of the Naval Research Lab took a close look at the Sun's coronal mass ejections, prominences of magnetized plasma that stretch millions of miles out from the solar surface. Chen's new model rejects the existing understanding of how these ejections work, instead finding that a magnetic "flux rope" is the cause of the size and strength of these ejections, a concept originally developed to understand containment in Tokomak reactors. Clifford Surko from the University of California San Diego discussed how plasma science carries over into the study and isolation of anti-matter as well. Greg Hebner from the Sandia National Laboratories delivered an overview of how plasma physics has been integral to developing new products and working towards energy independence.

The Division of Nuclear Physics held its annual meeting from November 2 through 6 at the Santa Fe Convention Center in Santa Fe, New Mexico. Emiko Hiyama of RIKEN explained recent advances in understanding baryon-baryon interactions, and Tim Gorringe from the University of Kentucky released results from his experiments with the MuLan Collaboration that have measured the lifetime of the positive muon, accurate to a single part per million. Similarly, Anatolii Serebrov from the Russian Academy of Sciences presented research that the lifetime of a neutron is roughly 1.1 seconds longer than previously thought, at roughly 879.9 seconds, with an uncertainty of .9 seconds. The important intersection of neutrino nuclear physics and cosmology was explored in depth by George Fuller, University of California, San Diego. The importance of nuclear physics to astrophysics and astronomy was a major feature of the meeting. Hendrik Schatz from Michigan State University gave an outline of how understanding the masses of nuclei are essential to understanding astrophysical events. Christian Ott of Caltech presented the first 3-D computer model tracking the core of a massive star as it undergoes gravitational collapse, and forms a proto-neutron star phase which subsequently collapses forming a black hole.

The joint OSA/APS conference Frontiers in Optics/Division of Laser Science was held October 24 through 28 at the Rochester Riverside Convention Center in Rochester, New York. At the meeting David DeMille of Yale and his team announced the coldest whole molecules ever created. Using three lasers to trap molecules of strontium and fluorine, DeMille was able to chill the molecules to 300 micro-Kelvins along one axis. Michael Romalis and his team at Princeton reported on their test confirming Lorentz invariance with accuracy improved by a factor of thirty. A new high-tech technique for looking at tooth decay was described by a team of researchers from the University of Rochester. They used Raman spectroscopy to distinguish the plaque strain *Streptococcus sanguis*, which fights decay, from the cavity-causing *mutans* strain. Friday morning began with a free tour of the Omega Laser Facility at the University of Rochester's Laboratory for Laser Energetics. Monday's plenary sessions featured Steven Block from Stanford University describing his work merging physics and biology to create new tools and applications such as using optical tweezers to trap biological macromolecules for study. Also at the plenary, Alain Aspect from the Laboratoire Charles Fabry de l'Institut d'Optique in France recalled how fifty years ago an experiment developed by R. Hanbury Brown and R. Q. Twiss to measure the angular diameter of stars ultimately led to the development of modern quantum optics.

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The Grid: Ready for Renewables?

By George Crabtree and Jim Misewich

The call for renewable electricity grows stronger as carbon emissions from electricity generation continue to rise. About 44% of US power is produced from coal, the most intense carbon emitter among the fossil fuels. Thirty states have passed Renewable Portfolio Standards (RPS) typically requiring 20% of electricity from renewable sources by 2020. Some states are more aggressive: California requires 33% renewable electricity by 2020, and New York 30% by 2015. The mandate for renewable energy is clear. The question is whether the grid can absorb this much renewable electricity without significant change in its technological, regulatory and business operation.

Renewable electricity possesses two features that challenge the grid's ability to embrace it: variable output and location far from demand centers. Compounding these challenges is the Balkanized grid in the continental United States. It is made up of more than 3200 utilities, three interconnections, and seven independent system operators, and it is controlled by state, federal, and local regulators. Renewable projects typically cut across these geographical, ownership, and regulatory boundaries, erecting multiple barriers arising from the disparate priorities of these decision-making bodies.

Wind and solar are the most common renewable electricity sources, now making up approximately 1.6% of electricity generation. The pace of installation, however, is fast: 30%-40% growth per year for both wind and solar. Wind is ahead in deployment, with over 35 GW of installed capacity to solar's 2 GW. Solar is poised for rapid advances, for example with the 400 MW Ivanpah solar thermal electricity plant now under construction in the Mojave Desert. We have a long way to go: the US uses electricity at an average rate of almost 500 GW. Weather, clouds and the diurnal cycle reduce actual solar and wind generation to about 15% and 30% of their installed nameplate capacity, respectively, and even lower in some areas and at certain times of the year. To meet the 20% RPS standard requires approximately a factor ten more installed wind and solar capacity.

Forecasting is emerging as one tool to accommodate the variability of wind and solar; however, this kind of renewable power forecasting is still in its infancy. These forecasts are not the usual weather reports giving the temperature and chance of rain, but high-resolution temporal and spatial wind and cloud forecasts that predict the output of specific wind and solar plants. They rely extensively, for example, on the generation history of specific wind and solar plants to predict power generation over minute, hour, and day intervals. Operators switch conventional fossil generation reserves in or out to smooth the expected variations in wind and solar generation.

Even on a scale of less than 2% renewable penetration, forecasting wind and solar variation is a technical challenge. Wind forecasts from different vendors for a given wind plant often disagree by factors of two or more, forcing operators to keep additional conventional generation in reserve just in case the forecast is wrong. The timing as well as the magnitude of the wind is important–a calm that comes two hours early can create a sudden downramp in wind power that might only be covered by curtailing service to some customers (who may have agreed in advance to such demand management protocols). Because wind and solar forecasting are relatively new, regulators have not yet defined uniform standards for methods, content or format of forecasts. Many private and government agency forecasters have developed their own distinctive styles for preparing and communicating forecasts.

At 20% penetration, the challenge of renewable variation will be ten times greater than now, raising the bar on the accuracy and confidence level of forecasts to avoid holding expensive "just in case" reserves at the ready. Storage of renewable electricity for future use is an attractive alternative. Storage smooths the generation peaks and valleys without the need for accurate forecasts or large pools of conventional reserves. It also makes money through "arbitrage"–storing low cost off-peak electricity and selling it at high prices on-peak, as pumped hydro operators do routinely. This additional income effectively reduces the cost of storage, making it economically more attractive to decision-makers. On the other side, regulators have little experience with storage and have not developed a standard framework for treating

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it. Storage leads a double life–it behaves like load when being charged and like generation when being discharged, defying traditional models of the grid. Beyond smoothing renewable supply, storage can significantly improve the utilization of transmission lines by "metering out" electricity so that the line always runs at maximum capacity, delaying expensive upgrades and benefiting customers in distant locations. Regulators and investors taking a local perspective often undervalue these benefits, so that storage looks less cost-beneficial than it actually is. Regulators need to identify the full spectrum of local and distant benefits in the business case for storage, clearly specifying how costs will be shared among beneficiaries and how they will be repaid.

There are many storage options out there, including conventional batteries, flow batteries, pumped hydro, compressed air, and thermal storage. The options differ dramatically in many ways; for example their energy density varies from 0.5 kWh/m^3 for pumped hydro to 360 kWh/m^3 for lithium ion batteries, a factor of over 700. Thermal storage is especially attractive for solar thermal electricity, because sun-heated molten salt can be stored for hours or even days and released when needed to drive a generator. Flow batteries are an attractive option for storing electricity in chemical bonds, using large tanks of liquid electrolyte to scale up energy storage capacity and independently controlling power by adjusting electrolyte flow rate through a redox reactor.

The location of wind and solar resources far from demand centers presents a transmission challenge. The best land-based wind is in a north-south corridor at midcontinent, and the best solar in the southwest. Tapping these sources requires transmission of large amounts of electricity over thousands of miles to population centers east of the Mississippi or on the west coast. The transmission system was not built for this purpose, but rather for serving local or regional customers, moving electricity at most hundreds of miles from specific known or expected sources to specific known or expected loads. For renewables we need an interstate highway system for electricity.

Superconducting DC transmission lines offer one innovative opportunity for an electrical interstate highway system. Superconducting cables can carry up to 5 GW of power at 200 kV instead of 750 kV or more typically required for conventional long distance DC lines. The lower voltage is a significant advantage for converting AC to DC and vice versa. Such conversions are done with semiconductor power electronics, whose small band gaps (~ 1 volt for silicon) require heroic networks of devices to reach high operating voltages. A second advantage is multiple entrance and exit ramps. Low voltage superconducting DC cables can collect electricity from many wind or solar plants over a wide area into a single cable and discharge electricity to multiple cities along its route; high voltage conventional lines must originate and terminate at a single source and sink. The Electrical Power Research Institute has shown that high capacity superconducting DC transmission cables can be integrated into the grid with no loss of stability or reliability.

The Balkanized grid offers a major challenge for renewable electricity. The generation plants, storage capacity, and transmission lines of a single renewable project can easily extend over many ownership, political, and regulation boundaries. This complex landscape breaks the project into pieces located within each jurisdiction and evaluated by each decision-making body according to its own criteria for cost and benefit to its local area. The value of distant generation, storage, or transmission is often excluded from business plan evaluation because it is located outside the jurisdictional boundary. Such Balkanized cost-benefit analyses often do not capture the full value of the project, making renewable electricity appear more expensive than it is. Regulatory agencies and investors need to establish a uniform evaluation process for renewable projects within a holistic framework that includes all the features of the project. For large projects this will cover many states, utilities, operators, and regulatory bodies. A unified vision of the grid integrating all its component parts is needed to capture the full value of renewable electricity.

Today's grid grew in patchwork fashion from small grids serving local markets with local regulatory and business perspectives. This system worked well when most electricity was generated tens or at most a hundred miles from demand centers, and when only a small fraction of that electricity was shipped to distant markets. By the end of the twentieth century the patchwork approach was reaching the end of its useful life. Electricity was deregulated and regional electricity markets were established allowing electricity to be bought and sold from multiple and more distant sources on the basis of price. Renewable electricity requires an even larger perspective, uniting sources and loads half a continent away. The benefits of connecting and coordinating the electricity grid on the national scale extend well beyond renewable energy. Increases in transmission capacity are critically needed–they have lagged behind increases in generation and use for decades. New storage technologies now being developed and demonstrated serve grid efficiency and reliability in addition to renewable integration. Implementing storage, transmission and a continental regulatory and business perspective creates an integrated and flexible national power backbone that not only enables renewable electricity but also shares electricity across weather and time zones, provides increased capacity for electric cars that replace foreign oil with domestic energy, and enhances reliability and redundancy that prevents cascading failures like the 2003 northeast blackout that affected 50 million people. It is time to modernize our historically patchwork electric grid with new technology for storage and transmission and new national regulatory and business perspectives that take full advantage of renewable energy, increased system reliability, and economies of scale.

The challenges of integrating renewable electricity onto the grid require a balanced portfolio of research and development spanning basic science, demonstration projects, and commercial deployment. The Department of Energy has the range to deal with these challenges in its basic research and technology offices, including Basic Energy Sciences, Electricity Delivery and Energy Reliability, Energy Efficiency and Renewable Energy, and the Advanced Research Projects Agency-Energy. For example, these offices have contributed enormously to advancing portable energy storage for electric vehicles; we must now build upon this foundation to develop grid scale electricity storage where the capacity needs and operating conditions are distinctly different. To enable renewable energy integration, the research and development challenges identified here must be raised to high priority and addressed with a balanced portfolio targeting long-term basic research needs as well as short-term development objectives.

This article is adapted from the Panel on Public Affairs report *Integrating Renewable Electricity on the Grid,* http://www.aps.org/policy/reports/popa-reports/upload/integratingelec.pdf.

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the Geological Society of America's conference in Portland Oregon, and even Comic-Con International in San Diego.

"Comic-Con International was a personal highlight," added Roche.

At Comic-Con the outreach team showed off their original comic books for middle school students featuring Spectra, the laser superhero who fights the evil Miss Alignment and explores the history of lasers and what they do.

The number of people reached has been tremendous. The OSA estimates that at least 6 million people have been impacted directly through events, exhibits, partners and student chapters, and many more through media coverage and news reports.

"I think it was fabulously successful," Hutchison said. "It was an incredible year."