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APS physics

Rethinking US Visa Policy
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APS to Review Statement on Climate Change

Preparations are under way by the APS Panel on Public Affairs (POPA) to review and possibly update the Society's statement on climate change. In the coming months, the APS membership will have a chance to weigh in on any proposed revisions before the Society adopts a final draft.

"We intend to keep the membership informed at every stage in this process," said Robert Jaffe, a physicist at MIT and Chair of POPA. "We're quite eager to make sure that the revision of the climate change statement is done in the most open and orderly way."

The subcommittee of POPA that is conducting the review posted its background and research materials to the APS website, along with its charge. The research materials include the transcripts of the subcommittee's January workshop, biographical information on outside climate experts who participated in the workshop, and their slide presentations. These materials are now available at http://www.aps.org/policy/statements/climate-review.cfm

The standing policy of the Society is to review its statements every five years. The Society first adopted the climate change statement seven years ago, but appended an addendum in 2010. The review also coincides with the release of the latest report on the physical science basis of climate change from the U.N.'s Intergovernmental Panel on Climate Change (IPCC).

"We intend to keep the membership informed at every stage in this process."

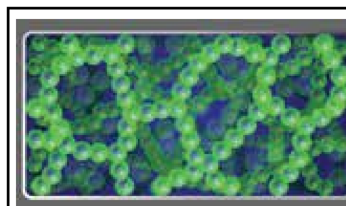
The months-long process started last year with the formation of the subcommittee and a steering committee, which is guiding the subcommittee through the review. In addition to weighing the opinions of experts from its workshop, the review subcommittee is researching information related to climate change and reviewing the roughly 1,500-page climate change report by the IPCC.

If a new statement is drafted, it will be submitted to the full POPA committee in June. If approved by POPA, it will go to the APS Executive Board for a vote. If approved there, the proposed statement will be posted on the Society's website for members to read and comment on, likely sometime later in 2014.

Once all of the comments have been collected, POPA will again review the statement and may revise it further based on members' input. It will then go to the Executive Board and the full Council for a vote on whether the statement should be officially adopted in its final form.

"We're not rushing this. Climate science and climate change will be around a long time and we want to get this right before sending it out to the membership for review and comment," Jaffe said.

Proposed Soft Matter Topical Group



APS/Alan Stonebraker

Illustration of particle networks responsible for the unusual properties of discontinuous shear thickening fluids.

Soft matter scientists are working to create an APS topical group for their research.

The organizing committee for the group is being finalized, and will soon start drafting by-laws and collecting signatures to form the group.

"It's our hope that the APS annual meetings become the 'go-to' meetings for soft matter in the US," said Sharon Glotzer of the University of Michigan, the chair of the organizing committee.

She added that members of the research community are working to create the new topical group because the field has been expanding over the last few years.

"Soft matter is one of the most rapidly growing areas of physics right now," Glotzer said. "You don't feel a strong presence of soft matter within the community because it's spread apart."

This subfield of condensed matter physics includes researchers working on foams, colloids, liquids, gels, and granular matter. The organizers have been working with other groups and divisions to coordinate the formation of the new group.

"The executive committee of DPOLY [the APS Division of Polymer Physics] is very pleased that APS has found a way forward to address the concerns and the needs of the soft matter community," said Karen Winey of the University of Pennsylvania and the chair of DPOLY. "Soft matter topics used

DPOLY continued on page 7

CUWiP Connects Women for Success

By Jessica Orwig

Undergraduate women studying physics have gained tremendous opportunities for networking and support over the last few years through the annual Conferences for Undergraduate Women in Physics (CUWiP). Since the first CUWiP in 2006, the number of students has exploded from 29 to over a thousand attending this year's conferences.

Compared with the single university that hosted the original CUWiP, eight universities across the country hosted this year's conference during the Martin Luther King weekend (17-19 January). The conferences are sponsored by the APS Committee on the Status of Women in Physics (CSWP), and former CSWP member Patricia Burchat chaired this year's National Organizing Committee.

"Our goal was for each participant to walk away from the conference with new confidence in her understanding of the role of physics in her own education, professional community, and in our global economy," said Donna Hammer, co-organizer of the Maryland conference.

The Maryland conference, also called the Mid-Atlantic CUWiP, was held at the University of Maryland. The other seven conferences

CUWIP continued on page 6

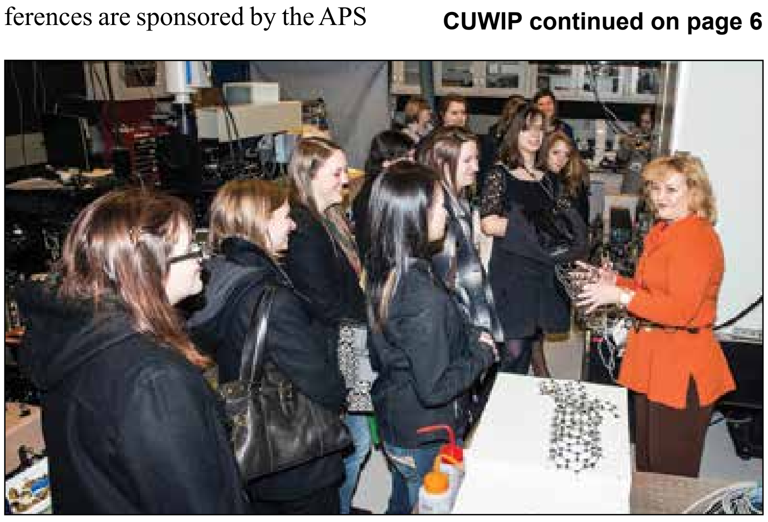


Photo by Curt Suplee

Students attending the Mid-Atlantic Conference for Undergraduate Women in Physics visited the National Institute of Standards and Technology. Here, they listen to NIST scientist, Angela R. Hight Walker.

Funding for Physical Sciences Shows Some Gains

By Michael Lucibella

Physical science research funding fared relatively well in the recently passed 2014 federal spending bill. Several science projects that had been facing cancelation or construction delays will be able to continue. However, the modest spending increases are uneven, and future budgets may not continue the trend. (see also Washington Dispatch, page 5).

"It's kind of a mixed bag," said Matt Hourihan, director of the R&D Budget and Policy Program at the American Association for the Advancement of Science (AAAS). "It looks pretty good for a few agencies but the news isn't good across the board."

President Obama signed the $1.1 trillion Consolidated Appropriations Act of 2014 into law on January 14, funding all the agencies of the federal government. It is the first comprehensive budget passed since 2009. The budget undid many of the mandatory spending cuts imposed by sequestration, particularly in the physical sciences.

"The general principle was to roll back sequestration," said Michael Lubell, director of public affairs at APS. "That's essentially what happened."

According to estimates by AAAS, non-defense research spending will increase by 7.6% over FY 2013 levels, or 2.5% over the 2012 pre-sequester levels. But when adjusted for inflation, it is actually about 1.5% below 2012 levels in real dollars.

The increases are not spread evenly across all agencies, however. Research at the Department of Energy (DOE) got a 20.4% bump in nominal dollars over 2013, meaning a 9.3% increase over 2012 or a 5.3% increase in inflation-adjusted dollars. Research budgets at NASA did similarly well, increasing by 10.8% over 2013, and 3.5% over 2012.

"I think a lot of these agencies are, I think its safe to say, ahead of the curve a little bit," Hourihan said, adding that many of the increases were moderated by inflation. "I think hopes needed to be tempered."

The National Institutes of Health, although they got a small bump, will remain about $700 million below 2012.

The Defense Department is the only research budget that decreased. Overall, DoD research will decline 1.6% from the 2013 mark , meaning a 10% drop from 2012. However, much of that decrease is from the department's applied research accounts. On the other hand, basic research got a boost, increasing 8.1% over 2013 levels, which almost keeps it at pace with 2012 inflation-adjusted levels.

The National Science Foundation (NSF) received only a modest bump as well. Their $5.8 billion overall budget represents a 4.2% increase over 2013, and 0.9% over 2012. Within the NSF however, research spending grew 6.1% over 2013 and a 2.4% increase over 2012, meaning that their budget for construction of new facilities shrank.

"That's one area where the physical sciences didn't do quite so well," Hourihan said.

The budget would restore NSF's ability to award grants to near pre-sequester levels, but construction of new facilities could feel a pinch. Projects already in progress will be prioritized, potentially squeezing the Large Synoptic Survey Telescope (LSST), the NSF's only construction project slated to start this year. But the project's leader thinks that the cut from $27 million to $17 million won't end up being an issue.

"The NSF is authorized to put additional money into the LSST if it can find it in their budget," said Steven Kahn, director of the LSST, adding that he felt confident the NSF would reallocate enough funding to keep the project on schedule.

Researchers on individual projects that had been facing shutdown or a delayed start have hailed the budget. Within DOE, the domestic

FUNDING continued on page 6

Members in the Media

"We now have the opportunity to determine what the sources are, if we are indeed seeing sources of cosmic rays….The big difference …is that we are not using light, we are using neutrinos to look at the sky."

***Francis Halzen**, University of Wisconsin-Madison, on the IceCube neutrino detector's capabilities,* FoxNews.com, *January 23, 2014.*

"This creation of a Dirac monopole is a beautiful demonstration of quantum simulation…. Although these results offer only an analogy to a magnetic monopole, their compatibility with theory reinforces the expectation that this particle will be detected experimentally."

***Lindsay LeBlanc**, University of Alberta, commenting on another team's creation of a "Dirac string,"* BBCNews.co.uk, *January 29, 2014.*

"Hawking's paper is short and does not have a lot of detail, so it is not clear what his precise picture is, or what the justification is."

***Joseph Polchinski**, the Kavli Institute for Theoretical Physics, on Stephen Hawking's recent surprising announcement that black holes don't exist,* The Christian Science Monitor, *January 29, 2014.*

"It's not possible to have both of those things, to have no drama at the apparent horizon and to have the information come out."

***Raphael Bousso**, University of California, Berkeley, on Stephen Hawking's recent surprising announcement that black holes don't exist,* The Christian Science Monitor, *January 29, 2014.*

"It's quite close to application.…Not too much extra needs to be done."

***Zhifeng Ren**, University of Houston, on a conductive material he's developing that's transparent and flexible,* The New York Times, *February 4, 2014.*

"Despite seeing them all the time, icicles are actually poorly understood."

***Stephen Morris**, University of Toronto,* The Washington Post, *February 4, 2014.*

"It's already a thing, but whether it will be blessed by Congress depends on how highly evolved the members of Congress are."

***Rush Holt**, U.S. House of Representatives, on his proposal for an official "Darwin Day,"* U.S. News and World Report, *February 7, 2014.*

"Mother Nature is pretty unforgiving–we're trying to stuff a lot of energy in a very small volume."

***Omar Hurricane**, Lawrence Livermore National Laboratory, on the National Ignition Facility's laser fusion experiments,* The Los Angeles Times, *February 12, 2014.*

"These results are still a long way from ignition, but they represent a significant step forward in fusion research."

***Mark Herrmann**, Sandia National Laboratories, on the National Ignition Facility's recent report that their laser fusion experiment produced more energy than it absorbed,* USA Today, *February 13, 2014.*

"Our nation needs a new, transparent, clean-energy policy that no longer turns a blind eye to the many negative impacts of coal burning –or to companies trying to sell coal to other nations playing catch-up in the global economy. A cornerstone of this policy must be the rational use of our vast reserves of Western coal as we ramp down the overuse of what is, by far, the dirtiest fossil fuel."

***Michael Riordan**,* The New York Times, *February 13, 2014.*

"We now know that if you go and buy a can of conventional house paint, any one of us can be a Picasso."

***Volker Rose**, Argonne National Laboratory, on using X-rays to identify pigments used in famous paintings,* AFP, *February 15, 2014.*

"We are not sure the government appreciates the role that basic research plays….The real question is, how does it view not-directed, non-industrial, curiosity-driven blue-sky research? I worry the view is that it is irrelevant at best and that in many cases they actually dislike it."

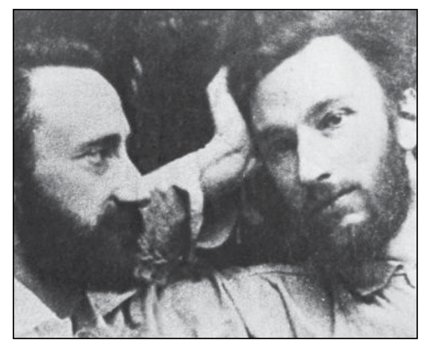
***Kenneth Ragan**, McGill University,* The International New York Times, *February 17, 2014.*

This Month in Physics History

March 1880: The Curie Brothers Discover Piezoelectricity

Microphones, quartz watches, and inkjet printers all rely on an unusual phenomenon known as the piezoelectric effect found in various crystals, ceramics, and even bone. It was discovered by none other than French physicist Pierre Curie, working with his older brother Jacques, who found that putting pressure on these materials created electricity (the name comes from piezein–Greek for "squeeze").

Born in Paris in 1859 to a physician named Eugene Curie, Pierre's early education was decidedly unorthodox: his father opted for private tutors for his son, believing it to be the best approach given the boy's temperament and keen intellect. Pierre showed an early aptitude for mathematics, and at 16 entered the Sorbonne for his university studies. He successfully earned the equivalent of a master's degree by 18, but was forced to postpone his doctoral studies. During this time, he earned a meager living as a lab instructor.



Brothers and colleagues: Jacques (left) and Pierre (right) Curie, discoverers of the piezoelectric effect.

Pierre started conducting chemistry experiments at the age of 20 with Jacques, focusing on the structure of crystals. They were especially interested in the pyroelectric effect, in which a change in temperature in a crystalline material generates an electric potential. This effect had been known since the mid-18th century, thanks to the work of Carl Linnaeus and Franz Aepinus, and subsequent scientists had hypothesized that there could be a relationship between the properties of mechanical stress and electrical potential. But experimental confirmation proved elusive.

The brothers Curie thought there would be a direct correlation between the potential generated by temperature changes and the mechanical strain that gave rise to piezoelectricity. They expected that a piezoelectric effect would arise in materials with certain crystal asymmetries. Armed with the crudest of materials–tinfoil, glue, wire, magnets, and a simple jeweler's saw–they tested various types of crystals, including quartz, topaz, cane sugar, Rochelle salt, and tourmaline. As a result, the Curies found that when such materials were compressed, the mechanical strain did indeed result in an electric potential. The strongest piezoeelectric effects were found in quartz and Rochelle salt. The brothers put their discovery immediately to good use by inventing the piezoelectric quartz electrometer.

There was a twist to the piezoelectric saga still to come. The following year, mathematician Gabriel Lippman demonstrated that there should be a converse piezoelectric effect, whereby applying an electric field to a crystal should cause that material to deform in response. The brothers rushed to test Lippman's theory, and their experiments showed the mathematician was correct. Piezoelectricity could indeed work in the other direction.

After the initial flurry of excitement died down, piezoelectric research faded into the background for the next 30 years or so, in part because the theory was so mathematically complex. But incremental progress was still being made. In 1910, Woldemar Voigt published the definitive treatise on the subject, *Lehrbuch der Kristallphysik*, a massive tome describing the 20-odd classes of natural crystal with piezoelectric properties. More importantly, it rigorously defined the 18 possible macroscopic piezoelectric coefficients in crystal solids.

This set the stage for subsequent development of practical applications for such materials, beginning with sonar in 1917, when Paul Langevin developed an ultrasonic transducer for use on submarines using thin quartz crystals. Many automobiles today have ultrasonic transducers to assist drivers in measuring the distance between the rear bumper and any obstacles in its path.

Pierre moved on to investigating magnetism, uncovering an intriguing effect of temperature on paramagnetism now known as Curie's law. Another discovery was the Curie point: the critical temperature at which ferromagnetic materials cease to be ferromagnetic. He even flirted with paranormal spiritualism as the 19th century drew to a close, attending séances with famed medium Eusapia Palladino, approaching them as a scientific experiment with detailed observational notes, in hopes that such study would shed light on magnetism. "I must admit that those spiritual phenomena intensely interest me," he wrote to his fiancée, Marie Sklodowska, in 1894. "I think in them are questions that deal with physics."

Pierre married Marie the following year, when he also finally completed his doctorate, thanks to her encouraging him to use his magnetism work as a doctoral thesis. He became a professor of physics and chemistry at Paris in 1895. (Jacques became a professor of mineralogy at the University of Montpellier.) His new wife replaced his brother as his scientific partner. The two discovered radium (and later, polonium), sharing the 1903 Nobel Prize in Physics with Henri Becquerel. The piezoelectric quartz electrometer invented by Pierre and Jacques all those years before proved an essential instrument in their ongoing work.

Towards the end of his life, Pierre showed early signs of over-exposure to radium. In fact, his clothes were often so radioactive he had to postpone experiments by several hours because it interfered with his instruments. The unit of radioactivity is called the curie in his and Marie's honor. But he was spared a gruesome death by radiation sickness. Instead, he was killed in a freak accident, run down by a wagon on the Place Dauphine as he was crossing the busy street.

Marie always felt Pierre did not get the respect and support he deserved from his scientific col-

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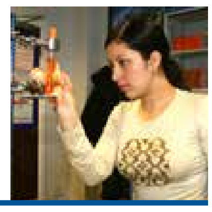
Education Corner

APS educational programs and publications



Save the date: 2014 PhysTEC Conference

The 2014 PhysTEC Conference will be held in Austin, Texas on May 19-20 in conjunction with the UTeach Conference. The PhysTEC Conference is the nation's largest meeting dedicated to physics teacher education.

This year's conference theme is "Building Leadership" and the conference features workshops, panel discussions, presentations by national leaders, and a contributed poster session. There will be a PhysTEC-UTeach joint plenary session by Arthur Levine, Woodrow Wilson Foundation. Other plenary speakers include Nicole Gillespie, Knowles Science Teaching Foundation; David E. Meltzer, Arizona State University; Susan Singer, National Science Foundation.

Registration opened in mid-February; the registration rate for PhysTEC member institutions is $150 and the non-member rate is $295. Faculty from minority-serving institutions are eligible to apply for travel grants. Additional conference information can be found at: http://www.ptec.org/conferences/2014

New APS K-12 Statement Passed

The New APS statement reads as follows:

The American Physical Society calls upon local, state and federal policy makers, educators and schools to:

- Provide every student access to high-quality science instruction including physics and physical science concepts at all grade levels; and
- Provide the opportunity for all students to take at least one year of high-quality high school physics.

Read more at http://www.aps.org/policy/statements/13_1.cfm

ALPhA's 2014 Laboratory Immersions Program

During the summer of 2014, the Advanced Laboratory Physics Association (ALPhA) will be offering a record number of sites for its popular "Laboratory Immersions." The Immersions offer an opportunity for faculty and teaching staff to spend two to three full days, with expert colleagues on hand, learning the details of a single experiment well enough to teach it with confidence. This year there are 14 sites offering a total of 28 different experiments, including new sites at Vanderbilt, Harvard, Sewanee, and the Princeton Plasma Physics Lab.
For details, including topics and registration, please visit http://www.advlab.org.

College Board Replaces AP Physics B

The College Board is replacing AP Physics B with a pair of two-semester courses. The text below is excerpted from the Board's "Big Changes on the Way for AP Physics" (available online).

As part of the Advanced Placement course and exam redesign, AP will offer two new physics courses beginning in fall 2014. These courses, AP Physics 1 and Physics 2, will replace the current AP Physics B course; as a result, AP Physics B will retire in fall 2014. This two-course physics model better reflects the introductory algebra-based college course sequence at most colleges.

As with all AP courses, the AP Physics 1 and 2 curriculum and exam development was overseen by a committee of college faculty members and AP teachers from across the country. The committee reviewed introductory-level AP Physics syllabi from colleges and universities across the country. This curriculum review helped the committee define which elements of introductory algebra-physics Physics were elemental and important to keep in the design of the revised curriculum. The final curriculum was also reviewed and validated by a separate panel of more than 50 physics faculty from a variety of institutions.

The first score reports for Physics 1 and 2 will be available in July 2015.

Read more on this change at: http://aphighered.collegeboard.org/exams/sciences/physics-b

CURIE continued from page 2

leagues. He did not engage in academic politics, preferring to focus on his research. He was rejected for a professorship in mineralogy and denied membership in the French Academy in 1903, the same year he won the Nobel Prize. His early work on piezoelectricity was not, perhaps, his most significant discovery over his illustrious career, but as he observed in an 1894 letter to Marie: "[In science] we can aspire to accomplish something…. every discovery, however small, is a permanent gain."

Further Reading:

Curie, Jacques and Curie, Pierre (1880). "Development, via compression, of electric polarization in hemihedral crystals with inclined faces," *Bulletin de la Societe de Minerologique de France,* 3: 90-93.

Curie, Jacques, and Curie, Pierre (1881). "Contractions and expansions produced by voltages in hemihedral crystals with inclined faces," *Comptes Rendus* 93: 1137-1140.

Hurwic, Anna. *Pierre Curie*, Translated by Lilananda Dasa and Joseph Cudnik. Paris: Flammarion, 1995.

Lippman, G. (1881). "Principal of the conservation of electricity," *Annales de Chemie et de Physique* 24: 145.

Former APS President Wins Top DOE Science Award

Former director of Lawrence Berkeley National Laboratory and former APS President Andrew Sessler received one of the nation's top science awards on February 3, 2014. Secretary of Energy Ernest Moniz presented the Enrico Fermi Award to Sessler for his "excellence in research in energy science and technology."

Sessler started working on accelerator physics in the early postwar years at Lawrence Berkeley National Lab (LBNL). When the Atomic Energy Commission became the Department of Energy in the 1970s, he helped guide the lab's new focus on energy research.

"Andy has made outstanding and very well known contributions to the establishment of beam physics that underpin many of the discovery tools we host today in many of our national laboratories," Moniz said. He added that Sessler's work on synchrotron light sources and high-intensity free-electron lasers helped lay the foundations for LBNL's Advanced Light Source and SLAC's Linac Coherent Light Source.

Photo by Roy Kaltschmidt, Berkley Lab

Andrew Sessler

In addition, Moniz praised Sessler's extensive humanitarian work. In the 1970s he founded Scientists for Sakharov, Orlov, and Sharansky, which championed the cause of the persecuted dissident scientists. The group organized an academic boycott of the Soviet Union and helped to fly their families to the United States.

"I am pleased that my contributions have been formally recognized and appreciated," Sessler said. "It shows to the world and the general public that it's not only movie stars and athletic heroes that are recognized and appreciated. It gives young scientists an understanding that their work is valued and even rewarded."

Sessler was director of LBNL from 1973 through 1980. He was President of the APS in 1998.

Also honored with the Fermi award was Allen Bard of the University of Texas at Austin, who is commonly referred to as "the father of electrochemistry."

Gaps Widen in Attitudes toward Science

By Michael Lucibella

According to a recent survey, public attitudes towards science and scientists generally remain supportive. Over the last five years, however, controversies over certain topics have deepened. The survey found also that 80 percent of Americans say they are interested in new scientific discoveries, a level of interest higher than in Europe.

"There are some very specific debates that have become politicized," said Cary Funk, a senior researcher at the Pew Research Center who helped conduct the surveys. "People on balance see more benefit than harm, but there are areas where they're concerned about GMOs [genetically modified organisms] or they're concerned about climate change."

The report found also that Americans generally believe the science behind climate change, and only about 30 percent describe themselves as skeptical. Although the report itself doesn't go into the specific political differences, presenters at this year's American Association for the Advancement of Science meeting said that political divide on the issue continues to grow.

"We have definitely seen a widening of the partisan gap," said Lydia Saad, a senior editor at the Gallup polling company. "Democrats' views have either remained strong or increased in their support of climate science while Republicans' [support has] weakened."

Speakers at the meeting said that there is a similar growing political divide over evolution as well. In 2012 fewer Republicans said humans evolved from apes compared to responses taken in 2009. Responses from Democrats and independents have remained about the same.

"We found really an amazing level of stability," Funk said, adding that over the last decade, about 60 percent of respondents indicate they believe in evolution. "What we found that had changed is a growing partisan gap."

"80 percent of Americans say they are interested in new scientific discoveries"

Funk added that this polarization was not necessarily unique to science. "Lots of issues have become politicized over the last decade if not longer," Funk said.

The biennial *Science and Engineering Indicators* report issued by the National Science Foundation always includes a chapter about public attitudes and knowledge of science. It brings together numerous surveys from a variety of polling organizations, including Gallup Inc. and the Pew Research Center.

"It's a wonderful trove of data about what Americans know about science… where they get their science news as well as questions about general attitudes," said John Besley, a professor of advertising and public relations at Michigan State University who contributed to the report.

The report also compiles international polling data. One survey asked people around the world nine basic factual questions about science to gauge the general knowledge in various countries. The survey included such questions as whether the Earth orbits around the sun. On average, people in the United States answered 64% of the questions correctly, which is about on par with nations in the European Union and generally ahead of the six other nations polled, including China, Russia, Japan and Malaysia.

The survey also highlighted a number of other recent findings. One is that for the first time, the Internet surpassed TV news as the American public's primary source of science news. It also found that 4 in 10 Americans said that the government spends too little on science and technology research and 5 in 10 say the spending is about right, a number that has been consistent for several years.

Physicists Ask Russian President to Help Kokabee

By Michael Lucibella

January 30, 2014, marked the third year of the imprisonment of physics student Omid Kokabee in Iran. APS awarded Kokabee its 2014 Andrei Sakharov Prize for human rights (see *APS News*, January 2014).

In January, Boris Altshuler, who won the Sakharov Prize along with Kokabee, sent an open letter to Russian president Vladimir Putin calling on him to use his influence with Iran to help free the imprisoned scientist. In February, APS President Malcolm Beasley sent a similar letter to President Putin.

A native of Iran, Kokabee was arrested by Iranian security forces at the Tehran airport while waiting to board a flight back to the United States, where he was studying for his doctoral degree. Since then he has been confined to Tehran's Evin Prison, which houses many of Iran's political prisoners.

According to a recent interview with Kokabee's mother, prison officials don't allow him to receive scientific papers, but that hasn't stopped him from continuing his research. Three local scientific conferences in Iran accepted papers he wrote while behind bars and invited him to present. He was unable to secure permission from the prison to attend.

In addition to writing papers, Kokabee also tutors other inmates in physics, mechanics, and civil engineering. However, prison officials have tacked on an additional 91 days to his sentence because of this. He translated a history of the Middle East and is in the process of translating a text on physics as well.

His family reports that since the beginning of his incarceration, his health started deteriorating. He's lost weight and started suffering from kidney stones and other digestive and dental issues.

Letters

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

The Bose in Boson

APS News (November 2013) reviewed the awarding of the 2013 Nobel Prize to Francois Englert and Peter Higgs for correctly predicting the existence of the Higgs Boson. Englert is quoted saying "The boson by itself is something that is the experimental test of the whole mechanism and one had to wait."

This is a very subtle comment. The strange particles found at CERN, their statistical behavior, and their ability to condense have been respectively named bosons, Bose Statistics, and Bose condensation after Satyendra Nath Bose of Calcutta University (1894-1974). Bose developed the concept and published the results in a seminal paper (1924) almost three quarters of a century ago.

During the "wait," major advances based on the boson have been made. The first experimental validation of the Bose theory [for atomic gases] was made by Wolfgang Ketterle, Eric Cornell, and Carl Wieman. They were awarded the Nobel Prize in Physics in 2001. The concept of particles acquiring mass due to interactions with an underlying field was predicted theoretically and independently by Francois Englert and Peter Higgs in 1964.

The prediction was validated through these experiments, and Englert and Higgs were awarded the Nobel Prize. Regrettably, the name of the originator of the boson concept and its properties, S. N. Bose, has rarely been mentioned in the published literature even as a footnote during these eight decades. "Stuff happens," as they say.

P. Mahadevan
Fullerton, California

Physicists Need to Engage with Congress and The Public

Having served for just over three decades, first as a research program manager and then as a senior science advisor for a federal agency with a history of providing substantial support to scientific research, I feel Michael Lubell is to be applauded ("Time to Hit the Road," *APS News*, December 2013). Lubell highlights issues relevant to understanding how the US Congressional legislative process affects the health of the nation's science enterprise: "...the prospects for a good science deal are poor unless the public gets behind such [initiatives]…" as "advancing the policies and authorization levels needed to strengthen American's science and innovation enterprise…." Moreover, he added "The public has little knowledge of the societal benefits of science...."

As cited by Lubell, scientists, with few exceptions, are not generally inclined to devote attention to the matter. From my experience, doing so will tax energy, time, and money from their efforts to conduct research, a talent that required years of training and practice. When asked about having to manage a research program with a relatively limited budget, the only answer I could provide in good conscience was to urge that congressional representatives be consulted. This advice remains appropriate today. In addition, it is clear that scientists would do well to reach out to the general public such as speaking before social clubs in their communities.

By coincidence, nearly 15 years ago, I came across the Aldo Leopold Leadership Program, which was designed to have its Fellows translate environmental science findings to inform the public, presented in layperson language. Establishing such a program for the physical sciences is viable and responsive to the advice cited in Lubell's column.

J. V. Martinez
Silver Spring, Maryland

Industrial Postdocs Offer Long-term Benefits

Brad Conrad, in his article "Renewed Focus on Early Career Physicists" (*APS News*, December 2013) makes many useful points about how APS can help non-academic-oriented physicists in the early stages of their careers. I believe he omits one such important aid.

Over the last half-century, a standard, well-recognized, route into academic physics was the postdoctoral position–basically short term, semi-independent research at a well established academic research institution. The APS served an important role in connecting new doctorates with available postdoctoral positions: advertising and assisting recruitment for existing positions and advocating for the financing of additional ones.

To the best of my knowledge, APS has not done the same for industrial postdocs. Small industrial firms are not likely to be in the position to offer many such useful temporary positions (useful to both the firm and the candidate postdoc), but the larger firms–GE, IBM, Boeing, etc–may very well be able to do so. I think it would be very useful for the APS (or its Forum on Industrial and Applied Physics) to attempt to proselytize among these larger firms for the creation of "industrial postdocs," pointing out to them the long-term benefits to them of creating a national cadre of well-versed non-academic physicists as well as the more obvious short-term benefits of augmenting their staffs with "new blood."

Perhaps a meeting of the senior science executives of these firms, called by the APS, could initiate a series of these well-publicized industrial postdoc positions. This could establish a new career route for newly graduated physicists and those seeking career changes.

Alvin M. Saperstein
Detroit, Michigan

A Victory and The One That Got Away

In his commentary "We Need Undirected Research" (The Back Page *APS News* January 2014), Byron Roe correctly states the need for self-directed research. He mentions Xerox and the personal computer as "A cautionary tale."

Throughout the history of both the laser xerographic printer and the Palo Alto Research Center's contributions to the personal computer, I reported either to Jack Goldman or George Pake. I became Director, Forward Technical Planning at Xerox corporate headquarters where I worked closely with George R. White, another physicist who was Vice-President for Corporate Planning.

Goldman, Pake, and White are all deceased, so I may be the best person to comment on Roe's "cautionary tale." Roe states that there was a lack of communication between the scientists and middle management. It was much more complicated than that. Goldman was a Senior Vice-President and a Board member of Xerox, while Pake and White were Vice-Presidents. All three were upper management. I was middle management. The conflict was between risk-averse MBA's and visionary PhD's at all levels.

We failed to carry the day regarding the personal computer. The ALTO research prototype ($80,000 per copy) was engineered to become the $16,000 Star, which had limited market appeal. Apple introduced the similar Lisa computer at $15,000, but adroitly followed up with the stripped-down Macintosh at just under $10,000. It didn't even have a modem at that price, but since the price tag was below a common $10K "capital request" threshold, many engineers could purchase one without justifying their decision. (They didn't know what it was good for yet, but they knew they wanted one.) Xerox didn't respond adequately to the Macintosh, and lost the moment.

We won regarding laser printers, but only through a ploy developed by White and me. We established four programs: three product programs–one each for high-speed, midrange, and low-end printers–and a fourth program that contained all the R&D spending. Financial analysts sniped at each of the product programs but were never able to suspend all three at the same time, so the R&D spending continued without interruption until the high-end laser printer got to market.

I am proud of my efforts in helping to bring the first laser printers, invented by Gary Starkweather, to market. I was elected a Fellow of the APS partly for that reason. As for the personal computer? You can't win them all.

Edward C. McIrvine
Asheville, North Carolina

Profiles In Versatility

An Arresting Career Brings Technology to Law Enforcement

By Alaina G. Levine

These days, if you want to take a bite out of crime, you are going to be aided by various technologies, ranging from simple databases to tasers to DNA fingerprinting. And yet most police departments do not have staff with science or engineering backgrounds.

"Police are an underserved market with respect to science and technology knowledge," explains John S. Morgan, a physicist and entrepreneur. Whereas the military industrial complex is designed to spur new research and innovations to enable success in and out of the battlefield, "police have nothing equivalent to this."

As a result, law enforcement organizations may spend billions of dollars on specialized equipment, but "are at a disadvantage because they have to depend on the vendor to tell them how to use it," he notes.

That's where Morgan comes in. His company, Coptech LLC, offers a "cost-effective solution" to police departments to help them understand science and technology that can improve their mission and aid them in navigating difficult technical problems. With over 17,000 law enforcement agencies in the US alone, including federal, state, and local police departments, as well as organizations that serve schools, parks and prisons, launching his company was a "no-brainer," he says.

Morgan provides value to his clients in numerous ways. One of his core mandates is to assist police departments in making intelligent decisions in purchasing technology and training officers, as well as in using and maintaining equipment. For example, while many departments buy and use tasers, the individual law enforcement professionals may not have a detailed understanding of how tasers function and how they impact the human body. His company offers instruction modules for cops to learn the physics behind taser technology, utilizing a Tesla coil to demonstrate voltage effects. At the same time, he educates police officers on how to use a taser properly to subdue a perpetrator. He is partnering with the International Academy of Public Safety to deliver web-based training across the country.

John S. Morgan

He trains law enforcement professionals to think like engineers or physicists when solving problems, whether they require technology or not. In fact, part of his charge is to create "police technologists," professionals who are tasked with running projects that are technology-related. "We teach the basics of systems engineering and how to relate a technological need to the mission of their agency," he says.

His other projects include assisting technology companies to better understand law enforcement issues so they can more successfully develop products to meet their growing needs, and international policing development. "The US spends very little money on helping foreign police departments," he notes. "And yet this is the front line of combatting terrorism and an extraordinarily important part of improving governance, especially in the developing world. Law enforcement is woefully undervalued in international relations and I'd like to fix this."

Morgan certainly has the skill set to lead these initiatives. With a BS in physics from Loyola College in Maryland and a PhD in materials science and engineering from Johns Hopkins, he served in the Maryland State Legislature while employed by the Applied Physics Laboratory (APL). In 1994, he was awarded an APS Congressional Science Fellowship and was embedded in the office of US Representative Dana Rohrabacher. He leveraged his time on Capitol Hill to learn as much as he could about the justice system in the US, so after he completed his Fellowship, he was able to transition into the Office of Science and Technology in the National Institute of Justice (the research arm of the Department of Justice (DOJ)) as its director.

At the DOJ, Morgan spent much of his nine years overseeing R&D programs to develop and deploy novel innovations to the criminal justice system, such as forensic technology (e.g., DNA testing, fingerprints), operational technology (e.g., body armor, less lethal weapons), and information and sensor technology. He feels that one of his most important accomplishments was spearheading a program that helped analyze millions of backlogged DNA samples nationwide, and altered the way DNA is used as a forensic, crime-fighting tool. "We changed the technology to make it better, improved the standards, increased the speed of analysis, and created a system in which new kinds of samples could be tested," he says. The White House and Congress invested hundreds of millions of dol-

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Washington Dispatch

Updates from the APS Office of Public Affairs

POLICY UPDATE: Appropriations

Using the Ryan-Murray agreement as the framework for appropriations, Congress finally passed a fiscal year 2014 (FY14) Omnibus spending bill with bipartisan support, by a margin of 359-67 in the House and 72-26 in the Senate. The legislation largely restored the sequestration cuts that had been triggered by the Budget Control Act as a penalty for congressional inaction on a long-term budget agreement. Neither party got everything it wanted, but each was happy to have achieved a result that could pave the way for a less chaotic budget process in the coming year.

Overall, science fared relatively well, although the outcome was very uneven. Some accounts saw increases above the sequester restorations. But some failed to achieve the full restoration.

Fusion Energy Sciences at the Department of Energy (DOE), for example, received a significant boost of 26 percent above the FY12 appropriated level, effectively reviving MIT's Alcator C-Mod facility and funding the International Thermonuclear Experimental Reactor (ITER), although not quite at the previously planned level of $225M. The National Institutes of Health (NIH), on the other hand, did not manage to reverse the sequestration cuts, falling about $800M below the FY12 level. And although the National Science Foundation (NSF) did receive an increase above FY12, its increase was not as large compared to some other discretionary accounts.

Strong advocacy by the scientific community surely helped stave off draconian cuts to basic research. In fact, while overall discretionary spending has decreased 13.6 percent since FY10, R&D has fallen by only 12.3 percent, with much of that decline absorbed by defense accounts not associated with basic research. Advocacy efforts have continued to keep science on the congressional radar as a bipartisan investment critical to future US economic competitiveness.

As inflation slowly chips away at the capacity of federal agencies to support research programs, proposal success rates will continue to ebb, although not as dramatically as forecast this year had sequestration remained in effect. Continued pressure on lawmakers by scientists will be necessary to reverse the long-term trend.

Of importance to prospective DOE grantees is the new funding model mandated for the department by the Omnibus bill. Grants of less than a million dollars must be fully funded in advance for the duration of the grant (typically three years). And to accommodate the new funding structure, DOE will be forced to reduce proposal success rates and funding levels for the next two or three years absent increases in appropriations.

The details in the FY14 spending bill are as follows, with percent changes from appropriated FY12 levels shown in parentheses:

NSF is funded at $7.20B in FY14 (+2.4%). The Research & Related Activities account is set at $5.81B (+1.5%), a slight disappointment relative to increases seen in other parts of the budget. The education portion of NSF, known as Education & Human Resources, is funded at $846M (+2.1%).

The DOE Office of Science is funded at $5.07B (+3.9%): Advanced Scientific Computing Research at $478M (+8.1%), Basic Energy Sciences at $1.71B (+1.3%), Biological and Environmental Research at $610M (-0.4%), Fusion Energy Science at $505M (+25.7%) with $200M of that set aside for ITER, High Energy Physics at $797M (+0.8%) and Nuclear Physics at $569M (+3.6%).

The DOE Energy Efficiency and Renewables (EER-E) and Advanced Research Projects Agency-Energy (ARPA-E) are funded at $1.91B (+5.1%) and $280M (+1.8%), respectively, and the National Nuclear Security Administration is funded at $12.13B (+5.4%).

The National Institute of Standards and Technology (NIST) Science and Technical Research and Services is funded at $651M (+14.8%), Construction of Research Facilities, at $56M (+1.8%) and the Industrial Technology Services, at $143M (+11.7%).

DOD 6.1 (Basic Research) is funded at $2.17B (+7.7%) and DOD 6.2 (Applied Research) $4.64B (-1.9%). The DOD 6.2 account was not only cut relative to FY12, but was also cut by 0.9 percent relative to FY13 post-sequester.

The National Aeronautics and Space Agency (NASA) Science program is funded at $5.15B (+1.1%) with continuing support for the James Webb Space Telescope containing strict instructions that its total budget not exceed $8B. The bill further instructs NASA not to engage in any bilateral talks with China, although the extent of the ban, as in the past, remains somewhat unclear.

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Thanking A Strong Supporter

APS President, Mac Beasley, along with Executive Officer, Kate Kirby, and Director of Development, Darlene Logan dine with major donor, Rosa Ovshinsky in San Diego, Rosa Ovshinsky and the Ovshinsky family have recently established an endowment to fund the new Stanford R. Ovshinsky Sustainable Energy Fellowship in his honor.

International News

...from the APS Office of International Affairs

Rethinking US Visa Policy to Compete Globally for Talent

By Albert H. Teich

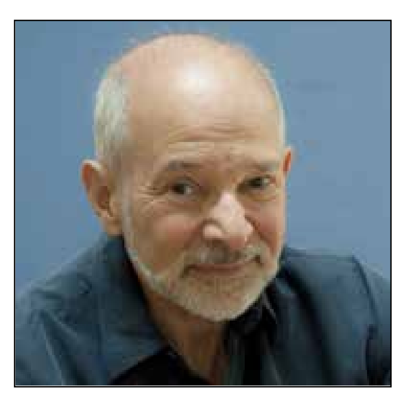
The United States has long been a magnet for top science and engineering talent from every corner of the world. The contributions of hundreds of thousands of international students and immigrants have helped this country build a uniquely powerful, productive, and creative science and technology enterprise that leads the world in many fields and is responsible for the creation of millions of high-value jobs. A few statistics suggest just how important foreign-born talent is to US science and technology:

- Over 30 percent of all Nobel laureates who have won their prizes while working in the United States were foreign born.
- Between 1995 and 2005, a quarter of all US high tech startups included an immigrant among their founders.
- Forty percent of Fortune 500 firms were started by immigrants or their children, among them Google, Intel, Yahoo, eBay, and Apple.
- Among the ten universities that produced the most patents, more than three out of every four patents involved at least one foreign-born inventor.
- More than five out of six (84%) information technology patents in 2010 listed a foreign national among the inventors.

But the world is changing. Countries that were minor players in science and technology a few years ago are rapidly entering the major leagues and actively competing for talent on the global marketplace. The advent of rapid and inexpensive global communication and air travel within easy reach of researchers from many countries have fostered the growth of global networks of collaboration and are changing the way research is done. Our visa and immigration systems need to change, too.

For the past year, I have been engaged in a study of the impacts of US visa and immigration policies on foreign scientists, engineers, and STEM students in light of the increasing globalization of science. Through this study, I've identified a number of important priorities that will help the United States respond to these developments and prepare for the future.

Take, for example, the section of US immigration law known as 214(b) that requires consular officers to treat every person applying for a US visa as an "intending immigrant." In practice, this provision means that a person being interviewed for a nonimmigrant student visa must persuade the consular officer that he or she does not intend to remain permanently in the United States. Just stating the intent to return home following completion of one's educational program is not enough. The applicant must present evidence to support that assertion, generally by showing strong ties to the home country. Such evidence may include connections to family members, a bank account, a job or other steady source of income, a house or other property. For a student, especially one from a developing country, this is often not a straightforward matter. It is not surprising, therefore, that the most common reason for denial of a visa application, including student visas as well as other major visa categories is 214(b), failure to overcome the presumption of immigrant intent.



Albert H. Teich

Section 214(b) of the Immigration and Nationality Act dates to 1952, an era when foreign students in the US were relatively rare. In 1954-55, for example, there were about 34,000 foreign students in the United States. In contrast, in 2011 there were nearly 765,000 foreign students in US higher education institutions, nearly two-thirds of them at doctorate-granting universities. In those early post-World War II years, the presence of foreign students was regarded as a form of international cultural exchange. Today, especially in STEM fields, foreign graduate students and post-docs make up a large and increasingly essential element of US higher education.

It's time to re-examine the application of 214(b) to STEM students in light of the fundamental changes in science and higher education that have taken place over the past 60 years. As NAFSA, the Association of International Educators, states in a recent policy brief, "Educated students are exactly the kinds of immigrants we should encourage to stay in the United States. We should not force them, before they even start their studies, to say that they have no intention of staying, working, and contributing to our country after they graduate."

The presumption of intent to immigrate is not the only hoop through which we put STEM students and potential science and engineering visitors. Others include the security review process code-named "Visas Mantis," the limits on H-1B visas (for foreign workers in specialized occupations), and the unnecessarily complex rules that govern J-1 visas (for exchange visitors).

Visa applicants who work in or intend to study certain technical fields or are from certain countries are frequently referred by consular officers to a security review involving nearly a dozen federal agencies. The "Visa Mantis" review is currently applied to about 10 percent of technical visitors, it is largely opaque, keeping applicants in the dark about their status, subjecting many innocent individuals to lengthy delays, and tarnishing the image of the United States as an open, welcoming society. Adding more consular officers with scientific or engineering training could facilitate screening applicants at the consulates and reduce the number of unnecessary Mantis referrals, allowing security officials to focus on serious security risks. Keeping applicants informed of the status of their applications during Mantis reviews would also help.

The H-1B visa category covers temporary workers in specialty occupations, including scientists and engineers in R&D. The program is capped at 65,000 each fiscal year, but an additional 20,000 foreign nationals with advanced degrees

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fusion research program was one of the top beneficiaries. For years the Department of Energy had to split its funding between domestic research and funding for the international ITER project in France.

"The domestic program has shrunk rather radically the last couple of years," said Stewart Prager, director of the Princeton Plasma Physics Laboratory. "It restores the domestic research program funding to a little bit more than it was in fiscal year 2012." He added that he felt that the budget represented a "turning point" for the field.

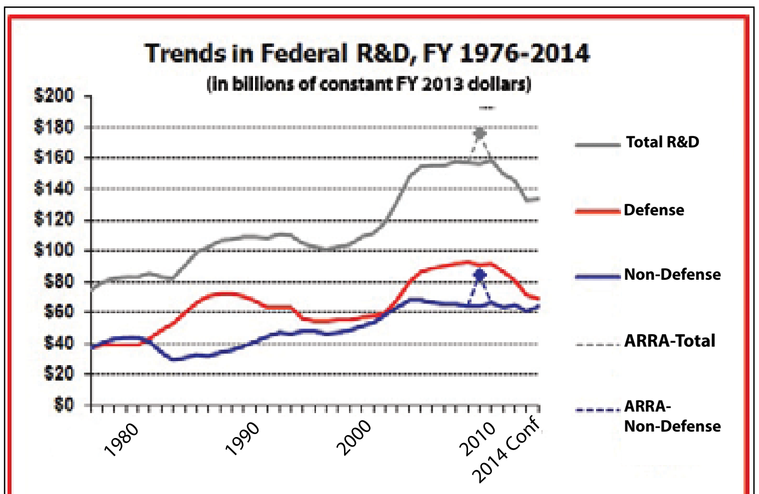
MIT has felt the brunt of the cutbacks. In 2013 their primary research tokomak, the Alcator C-Mod, was slated for shutdown as a result of budget cuts. The 2014 budget restores much of the funding for the program.

"Depending on how much funding we get…[we will] probably try to do between 12 and 14 weeks of research," said Earl Marmar, division head of the Alcator project at MIT, adding it was still down from 19 weeks in 2012. "It's very good news for us, but it's also very good news for the whole fusion program."

Brookhaven's Relativistic Heavy Ion Collider also got a reprieve. It was facing funding cuts after a DOE/NSF advisory panel gave RHIC a lower priority than other nuclear physics facilities that were straining the budget. At the same time, DOE said it was committed to keeping RHIC running.

"We're absolutely thrilled–it's not plush but it is allowing us to have a 22-week run this year," said Berndt Mueller, the associate laboratory director for nuclear and particle physics at Brookhaven. "Having a full 22-week run is the best thing that could have happened."

At Michigan State University,



Source: AAAS *Research and Development* reports and analyses of appropriations. FY 2013 figures are current estimates. ARRA = American Recovery and Reinvestment Act of 2009

construction is about to move forward for the new Facility for Rare Isotope Beams (FRIB).

"The passing of the federal budget allows the commencement of construction of FRIB," said Thomas Glasmacher, the project manager of FRIB. "Under a continuing resolution you can't start–there are no new starts."

One of the lingering questions hanging over the high-energy physics community is whether Fermilab's new project, the Long Baseline Neutrino Experiment (LBNE), will have enough funding to bury its detectors in an underground laboratory in South Dakota. It is expensive to build and run large liquid argon detectors 4850 feet under Earth's surface, and the Department of Energy's office of science has previously balked at its billion-dollar price tag.

"We are proceeding on the assumption of an underground detector," said Jim Strait, project manager of LBNE. "The international partners are really only interested if we have an underground detector."

The omnibus budget doesn't allocate funds for the detector, but it nearly doubles the $14 million budget to get construction started. There is still at least a $600 million gap in the funding to locate the detectors underground, but Strait hopes to partner with other nations to make up the difference.

"The big issue is to assemble a big international collaboration to allow us to do the experiments in a timely way," Strait said. "The additional funding makes it look as if the US is serious about doing this."

Looking ahead, experts said that it's unclear if those trends will continue in the future. The president's budget request is due out in early March.

"The FY 15 agreement is to keep spending frozen at more or less 2014 levels" Lubell said. "Except for the Defense Department, I think it will look pretty much the same."

Hourihan agreed, but cautioned there was only so much about next year that can be divined from this year's budget agreement.

"These FY 14 numbers may end up being a new plateau," Hourihan said. "I think the chances of the increases we saw in the omnibus are pretty slim."

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lars in support of the President's Advancing Justice Through DNA Technology initiative, and Morgan was awarded the Service to America Medal, the highest honor a civilian can receive, for his contributions. He later served as the Command Science Advisor to the US Army Special Operations Command, where he oversaw research in myriad technical arenas, including bomb-detecting robotics, night-vision gear, and information analysis.

But all of these experiences in fighting crime and terrorism wouldn't have been possible without a foundation in physics, argues Morgan. Not only does it bolster his problem-solving abilities, but it also "gives me instant credibility because police departments are hungry for information on science and technology and they want someone with real credentials to help them."

As technology continues to pervade every corner of society, Morgan predicts that opportunities for physicists in the law enforcement community will also grow. "I love the purity of science for science's sake, but there's wonderful satisfaction in seeing science and technology put into practice in a practical way," he says. Currently there is a desperate need for analysts and data scientists, especially with an uptick in electronic crime, he notes, but there are other avenues in which physics-educated professionals can contribute. "People with physics backgrounds have more to offer in this landscape than they might realize," he says. "For someone who is creative and interested in stepping out of their comfort zone, this is the industry for you."

Alaina G. Levine is the author of Networking for Nerds *(Wiley, 2014) and President of Quantum Success Solutions, a science career and professional development consulting enterprise. She can be contacted through www.alainalevine.com, or followed on twitter @AlainaGLevine.*

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NIH was funded at a rather disappointing $29.90B (-2.5%), which is ~$800M less than in FY12.

Finally, the Office of Science and Technology of the President was funded at $5.5M (+23.4%).

WASHINGTON OFFICE ACTIVITIES
ISSUE: MEDIA UPDATE
Michael S. Lubell, director of public affairs, opined that science offers a path for bipartisanship in his Jan. 24 op-ed in *Roll Call*. He cited the helium reserve bill as an example of how Congress can work together to accomplish great things for the nation. Read the column: http://bit.ly/1clZdAy

Following word of the proposed move of the Air Force Office of Scientific Research, *Science* published an article detailing the scientific community's opposition to the plan. Read the story:http://bit.ly/1cVw785

ISSUE: Panel On Public Affairs
A proposed APS Statement on Undergraduate Research was posted on the APS website for review by APS membership. POPA reviewed the member comments and worked with the APS Committee on Education to include several edits. The statement was forwarded to the Executive Board and Council for a final vote.

POPA is undertaking a review of the APS 2007 Statement on Climate Change. Information about the process can be found at: http://www.aps.org/policy/statements/climate-review.cfm

The APS Committee on the Status of Women in Physics and the APS Committee on Careers and Professional Development have both approached POPA with proposed APS statements. The POPA Subcommittee on Physics & the Public is working with those committees on draft statements that will be considered by POPA at its June meeting.

Several ideas for POPA studies were suggested by new members at the February meeting. Any APS member can propose that POPA carry out a study. A template for proposals can be found online, along with a suggestion box for future POPA studies: http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm.

CUWIP continued from page 1

were the Southeastern Conference at Florida State University, South Central Conference at Louisiana State University, Northeast Conference at Pennsylvania State University, East Conference at Stony Brook University/Brookhaven National Laboratory, West Conference at UC Berkeley, Midwest Conference at University of Chicago/Argonne National Laboratory/Fermi National Accelerator Laboratory and the Rocky Mountain Conference at the University of Utah.

During the three-day conference, students had the opportunity to present their undergraduate research in poster sessions, participate in career workshops and panel discussions, and network with one another. They also heard from professional physicists, both female and male, about cutting edge physics research.

Learning from these invited speakers offered some of the most inspiring moments for Noura Jaber, who attended the conference at the University of Maryland. Jaber is a freshman at Bryn Mawr College in Pennsylvania and first learned about the conference while chatting with Angela Walker. Walker is a senior scientist at the National Institute of Standards and Technology and was one of Maryland's CUWiP panel speakers this year.

"It's nice to see women take leadership roles in the physics world," said Jaber, who was referring to one of UMD's invited speakers, Ellen Williams. Williams is Chief Scientist at the BP energy company and a distinguished professor of physics at the University of Maryland. Last November, President Obama nominated her for the position of Director of ARPA-E (the Advanced Research Projects Agency-Energy) in the Department of Energy (DOE).

Jaber said that learning "how [Williams] got there and how she managed to develop leadership roles" was inspiring and described Williams' confidence as contagious. Jaber plans to declare her physics major next year when she's a sophomore.

Jennifer Liang, another undergraduate physics student who attended the Maryland conference, said that she was surprised to see the large number of women at the conference.

"I didn't know there were so many women in physics," said Liang, who is a junior at the University of Maryland. "It has inspired me to…keep moving toward my goals." Liang plans to apply to graduate school in physics next year.

Since 2012, APS has helped coordinate these conferences by facilitating registrations and co-organizing events with host institutions. This year, APS received about 880 new female student members as a result of the registration process and even more attended the conferences, explained APS Women and Education Program Administrator, Deanna Ratnikova.

"When students applied to attend the conferences, they were given the option to opt-out of the free one-year student membership," Ratnikova said. "If they did not opt out, they were awarded free membership for a year….the attendance for the 2014 conferences was 1006 students."

One of this year's APS representatives, Careers Program Manager Crystal Bailey, gave a talk entitled "Breaking the myth of the non-traditional physicist." Students first entering physics as undergraduates may think that pursuing a career in academia is the norm, but Bailey explained that is not the case.

"When you look at the statistics," Bailey said, "industry has been the largest employment base for physicists with PhDs in the last 30 years."

"The sooner we start telling students about the real employment picture," she said, "the longer they will have to design a path that makes sense for them and gain the skills they need to be successful in the path they choose."

In addition to staff support from APS, the conferences received financial aid from the National Science Foundation and DOE which together will provide about $210,000 to support these conferences each year through 2016. The bulk of the funding, however, came from individual sites, which assembled more than $440,000 for this year's conferences.

ANNOUNCEMENTS

Correction

"This Month in Physics History" (*APS News*, February 2014) recounted James Chadwick's discovery of the neutron. Owing to an editing error, the statement "Chadwick replicated a German experiment in which polonium struck a beryllium target..." is incorrect. The alpha particles from the polonium, not the polonium itself, struck the target Thanks to Charles Kaufmann of the University of Rhode Island for bringing this to our attention. We regret the mistake.

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to be scattered between many units and now it will be coordinated by one unit."

Once the working group is assembled, it will start to draft the proposed group's bylaws. At the same time, they'll start circulating a petition to collect the 200 signatures needed to bring the proposal before the APS Council for approval in April.

Once approved by the Council, the group becomes officially active. After 200 members sign up, it becomes a full-fledged topical group and if the timing works out could potentially start organizing sessions for the 2015 March Meeting.

The formation of the group would be the culmination of several years of grassroots effort to establish a home for soft matter researchers.

"Europe has a very strong soft-matter community," Glotzer said. "We don't have the same kind of thing here in the US."

The effort also comes in part as the Society tries to expand its appeal among industrial physicists.

"There was specifically an effort to include industry," said Trish Lettieri, the director of APS Membership. "The timing is right to help us achieve some of the goals APS identified in its strategic plan."

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from US universities are exempt from this ceiling and all H-1B visa holders who work at universities and university and government-affiliated nonprofits, including national laboratories are also exempt. Presumably intended to strengthen US science and engineering capabilities by bringing in international talent, the program has been exploited by firms (mainly from India) that outsource information technology workers (programmers, software developers) to US clients. One relatively easy fix for this problem might be to expand the exempt subcategories of H-1Bs to include all PhD scientists and engineers engaged in R&D, not just those at universities and nonprofits, thus putting them in a separate class from those using the program for outsourcing of IT personnel.

The J-1 exchange visitor visa, which covers research scholars and professors, is entangled in a maze of rules and regulations. There are restrictions on how long a visitor may remain in the United States that depend on the dates and durations of previous visits. There is a two-year home country residence requirement that applies to some visitors and there are 12 and 24 month bars that prevent visitors from returning to this country, again depending on various factors. There are reasons behind each of these rules, but together they create an unnecessarily complex picture to potential visitors and those who would invite them to US labs and classrooms.

Up to now, we have still managed to attract large numbers of top STEM students, postdocs, and senior scientists and engineers. But other nations are not just standing by idly and watching. They know how important scientific and engineering talent is to their futures. China, India, and South Korea, among others, have set up programs to draw expatriate scientists back home. They are offering attractive salaries and funding to set up labs and hire staff. In 2011, China established a "Thousand Foreign Experts Program" explicitly aimed at foreign scientists and entrepreneurs. Korea has opened a "one-stop" center to help foreign researchers immigrate. Canada has created a new visa program to attract foreign entrepreneurs. Australia, Chile, and Brazil are among the other nations with programs to attract international scientists. As US federal agencies and universities see their budgets shrink and the US visa and immigration system remains locked in the past, the appeal of such programs to scientists who might otherwise come to the United States grows. The changes advocated here and others explored in this study can help level the playing field and maintain the position of the United States as a world leader in science and technology.

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Urban Physics

By Steven E. Koonin, Gregory Dobler, and Jonathan S. Wurtele

While physics is a science, it is also a set of tools and a state of mind. Physicists have repeatedly found intellectual and practical benefit in applying their methods to new subjects; astronomy, biology, and earth sciences are prominent examples. The study of cities is another such subject now ripe to be taken up by physicists.

Understanding cities is a pressing global problem. Currently about 80% of the US and about 50% of the world population reside in urban areas, growing at over one million people per week. A city is a complex mix of infrastructure, environment, and people that must provide safety, health, housing, mobility, water, food, energy, interactions, and more recently, connectivity for its citizens. We must build new cities wisely and refurbish existing cities while improving efficiency, quality of life, and resilience.

Physicists Luis Bettencourt, Geoffrey West, and co-workers have recently offered phenomenological explanations of several macroscopic aspects of cities through theories based on scaling and network ideas from biology [1]. But what makes the science of cities even more worthy of physicists' attention now is a growing tsunami of urban data. Much as the data revolution has transformed our understanding of the physical world (e.g., the Large Hadron Collider, the Sloan Digital Sky Survey), the rapid proliferation of all manner of sensors throughout society, the digitization of commercial and governmental records, and advances in computing power and computational techniques can be combined to create unprecedented insights into urban structure and dynamics.

CUSP's Urban Observatory view of the east side of lower and midtown Manhattan from a rooftop in downtown Brooklyn. The night scene consists of major and minor building lights, street and river lights, and roughly 10,000 window lights. An 8 megapixel visible camera acquires three-color visible images every 10 seconds. Privacy protections include a resolution no finer than a few pixels/window.

Granular real-time data can now show how city systems operate individually and how they interact, both with each other and with people. Sensors can report real-time traffic conditions, utility supply and consumption, bus, subway, and taxi activity, environmental quality, and crime. Social media, such as Facebook, Twitter, and Foursquare, and mobile devices that record exercise regimes and physiological parameters provide new data streams on what people are doing, how they are feeling, and what they are observing. In aggregate, these data streams are signatures of the functioning of the city and the quality of life of its inhabitants. Applying the same concepts of scientific inquiry that physicists use on a daily basis can yield new insights into how those cities work and how they can be better.

NYU's Center for Urban Science and Progress (CUSP) [2] was created in April 2012 to realize the potential of urban science. Now almost two years later, CUSP is developing into a unique interdisciplinary institution with research, educational, and entrepreneurial components designed to study and interact with New York City (NYC). CUSP aims to accelerate the definition, development, and application of the emerging field of Urban Science and Informatics.

Stakeholders

CUSP's diversity of stakeholders reflects the many segments of society that come together in cities. As a mission-driven academic institution, university partners are central to CUSP's culture and identity–advancing the frontiers of urban science and educating the next generation of researchers and practitioners is at the core of the mission. Private sector participation is essential if CUSP insights and innovations are to have impact at scale–researchers from corporate partners facilitate both technology transfer and scaling of CUSP's work. CUSP's national lab partners find an opportune venue in which to develop and exercise their sensing, data management, and modeling capabilities. But the most important stakeholder is the NYC government–CUSP's close partnerships with city agencies allow access to data, guidance in problem definition, and opportunities to demonstrate solutions.

Urban data has private sector, academic, civil society, and public sector uses. Examples include:

- Optimizing systems in real time (traffic and transit flows, gas/water/electrical grid, services delivery such as EMS, …).
- Improved infrastructure planning (land use, public transit routes, roads, utility systems)
- Monitoring the condition of infrastructure (e.g., joint corrosion in bridges, potholes, pipe leaks and blockages, insulation in buildings)
- Preparing for and managing abnormal conditions (hazard detection, emergency preparations, and emergency response)
- Increasing transparency and equity in the distribution of city services.
- Enhanced monitoring of public health (spread of infectious diseases, behavioral and environmental impacts)

In many of these examples, benefits are amplified by an open data architecture that promotes an increased understanding of the urban system in all sectors of society.

Research and Education

Four CUSP facilities are being created to anchor its research projects. First, the Data Warehouse curates and controls NYC-relevant datasets from diverse sources, including open city data, proprietary commercial data, and data generated by CUSP itself. The notions of data curation and data "users" are familiar to the high-energy physics and astronomy communities. Curating open data, which come from disparate city agencies in a wide range of formats, is a useful and important task. The Data Warehouse balances desires for openness against the proprietary and privacy concerns of the data sources.

Unlike physics datasets, much urban data is about people, entailing the need to ensure the individual privacy of the citizens whose collective behavior is being studied. Both the government and the private sector routinely collect diverse personal information. Privacy is therefore of utmost importance for CUSP's work, reflected in the responsibilities of its Chief Data Officer and the approval of the NYU Institutional Review Board for projects that involve more than open data. Other privacy safeguards include strict data access rules, immediate data encryption, and degrading of information. CUSP and its partners aspire to develop and demonstrate best practice in the responsible and transparent use of personal data in research and for public good, not only through norms and procedures but also through implementation of new technologies.

The second facility is the CUSP Urban Observatory (UO), created to observe significant regions of the city at multiple wavelengths. Multiple urban vantage points (e.g., tall buildings) afford platforms from which sensors can persistently and synoptically cover the city without the mass, volume, power, or data rate constraints inherent in aircraft or satellite observations. The range of current or future instrumentation includes multiband visible imaging, broadband IR imaging (SWIR, MWIR, and thermal), hyperspectral imaging (to measure trace gases, building surfaces), LIDAR (to study building and bridge motions as well as pollution), and radar (building and street vibrations, building motion, traffic). Important correlative data includes meteorology, topography and geolocation of scene elements; parcel and land use data, demographics, etc.

The UO has begun optical imagery of NYC, providing an excellent example of how physics finds application in CUSP. Processing nighttime images (see Figure) with well-known astronomical analysis techniques such as image registration, source identification (think of the individual windows as variable stars), color analysis, time series analysis and statistical procedures, is yielding aggregate patterns of temporal variation. Those patterns–and their variations with weather, day-of-week/ month/ season, and special events (holidays, daylight savings, elections, etc.)–are directly relevant to questions such as sleep/wake patterns, proxy measures of energy consumption, and correlation with aggregate demographic data.

The third CUSP facility is the Quantified Community. Here, some 10,000 people would live in a fully-instrumented new residential/commercial development. Simultaneous monitoring of the infrastructure, the environment, and behaviors will afford a "living laboratory" to study a slice of the city and allow controlled assessment of technology or policy interventions. What will be measured, how it will be measured, what will be learned, and privacy protections are all questions under consideration in the current definition phase of the project.

The fourth CUSP facility will be an integrated simulation of the city. Reduced models might provide insights into urban dynamics, but they must be complemented with integrated, high-resolution, validated, high fidelity models of urban systems. An integrated city model would combine traffic and land use codes with communications, economics, energy, etc., likely in an agent-based formulation. None of this is straightforward and the challenges include incorporating city "boundary conditions," determining realistic decision rules, developing methods to verify and validate complex models involving human behavior, and exploring the limits of predictability.

Urban science offers robust opportunities to use the evolving tools of citizen science. CUSP is beginning to work with citizens of New York–volunteers who acquire data using personal, mobile environmental, or stationary home sensors and who analyze data by donating computational cycles, their personal expertise, and creating apps for data visualization and analysis.

CUSP grants MS degrees in Urban Informatics, and a PhD degree is under development. The current class has 24 students, and the number is expected to rapidly increase. CUSP's educational program is defined by its strong applied component in which its students and researchers work with NYC agencies on specific problems. Examples include:

- The quantification/characterization of noise throughout the city on a 24/7 basis via in situ measurements, complaint calls, and other correlative data.
- The analysis of taxi data (pick-up/drop-off locations, time, fare, tip are available for each of the 180 million trips that occur each year) to understand mobility and economic behavior.
- The study of building energy efficiency using a combination of self-reporting, synoptic sensing, and comparative analysis using correlative data.
- The development of novel public health monitoring methods such as the genomic profile of sewage.
- The in situ monitoring and study of environmental particulates and their sources, e.g., trucks, buses, etc.

Conclusion

In many ways, CUSP resembles a "national laboratory for cities", with a strong applied research component coupled to New York City. Its researchers and students work with the city on real problems, where success is measured "on the street" or in fiscal/operational terms. CUSP physicists must work with data and computational scientists, electrical and civil engineers, social scientists, and city operators. The difficulty of understanding how complex systems work, which appeals to many physicists, coupled with an opportunity to have a positive impact on society, brought us to urban science. To successfully contribute to this new field, physicists will have to understand the accomplishments, questions, and challenges of urban research in the social sciences, a task facilitated by CUSP's interdisciplinary structure.

Physicists are trained to solve complicated problems, to handle large data sets, to develop new instrumentation, to work with interdisciplinary teams, and to apply careful experimental and modeling procedures to avoid self-deception. They have a tradition of organizing large groups of scientists focused on specific research questions. It is precisely those qualities that will enable physicists to make important contributions to 21st century urban science.

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1. L. Bettencourt, et al., PNAS 104, 7301 (2007), doi:10.1073/pnas.0610172104; L. Bettencourt, *Science* 340, 1438 (2013) doi:10.1126/science.1235823
2. See http://cusp.nyu.edu