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

April 2013 • Vol. 22, No. 4

PRL Editor Takes Stock
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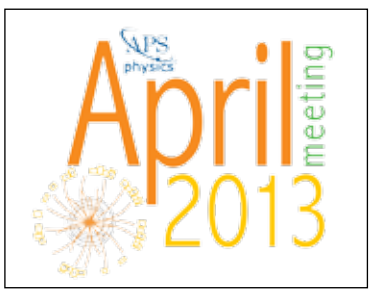
Niels Bohr and Much More at April Meeting

Physicists the world over will soon be converging on the Mile High City for the annual APS April Meeting, being held this year from April 13 through 16 at the Sheraton Denver Downtown Hotel in Denver, Colorado. The meeting will draw more than 1,200 physicists to share the latest results in particle physics, nuclear physics, astrophysics and plasma physics research. There will be 72 invited sessions, more than 120 contributed sessions and three poster sessions.

Kavli Keynote

Saturday morning's Kavli Keynote Session (A1) will kick off the meeting by highlighting some of the amazing high energy, quantum and astrophysics research being conducted around the world. John Harris of Yale University will present recent results from the LHC's collisions creating quark-gluon plasma, and the insights it offers. Nobel laureate David Wineland of NIST will talk about his research into quantum entanglement and information using trapped ions. Lloyd Knox from the University of California, Davis will present the sky maps of the cosmic microwave background generated from data taken by ESA's Planck telescope.



Bohr's Atom at 100

2013 marks the 100th anniversary of Niels Bohr's discovery of the quantum atom. Physicists and historians will speak about the important milestone throughout the week. At Monday morning's plenary session (P1.01) John Heilbron of the University of California, Berkeley will share fresh perspectives on Bohr's thinking and the influence of his wife Margre the drawn from soon to be published letters written by the acclaimed physicist. In addition, on Tuesday morning, a full session (X7) will be devoted to recapping the importance of Bohr's new paradigm in understanding the quantum structure of atoms, and the lasting effects it's had to this day.

Other Plenary Talks

Other plenary sessions will highlight new and exciting directions in physics. On Tuesday morning (W1) Geralyn Zeller from Fermilab will review some of the important recent neutrino experiments and discoveries, such as the smallest mixing

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OSTP Memo Sets Goal of Public Access

A recent memorandum issued by the Office of Science and Technology Policy (OSTP) sets a goal of making direct results of federally funded science, including peer-reviewed publications and digital data, freely accessible to the public to the greatest extent possible, consistent with law and other objectives, including the continued availability of peer review. OSTP directs each Federal agency with over $100M in annual research expenditures to develop, within six months, a plan for public access, after consultation with stakeholders including researchers, universities, libraries, publishers, and representatives of other potential users.

The memorandum, issued on February 22, comes in response to a petition submitted to the White House's "We The People" website, which received more than 65,000 signatures. The memorandum urges agencies to cooperate on their plans, where appropriate, and directs that funds for implementation should come from within existing agency budgets.

The memorandum has been generally greeted with cautious support from publishers of scientific journals. It specifically mentions the role that publishers play in organizing peer review, and allows agencies to craft policies suited to individual scientific fields and agency missions. In particular the memorandum gives a twelve-month embargo period as a guideline for public access to published papers, but allows stakeholders to petition for different embargo periods.

In a statement on its website, APS similarly highlighted the important role that publishers play in the scientific enterprise.

"The APS supports the principle of making federally supported research available to the public and is in the process of evaluating the potential benefits and impacts of the OSTP directive," the statement reads. "The APS will work with federal agencies to develop public access policies that best meet the needs of the science community and the American taxpayer."

As reported in the February *APS News*, APS has established a high level Task Force to coordinate its policy on open access. APS's Treasurer/Publisher Joseph Serene said that he and other members of the Task Force appreciate the flexibility provided in the memorandum. He added that they look forward to helping agencies develop plans that meet the OSTP goals while protecting the Society's high-quality peer-reviewed journals.

"We support open access to the greatest extent possible consistent with the health and stability of our journals," Serene said. "The basic message of the OSTP memo is entirely consistent with what APS policy has always been."

"We are very concerned that implementation of the OSTP directives allows high quality scientific publishers to continue providing the essential services such as peer review, powerful online platforms, and secure archiving," Serene said. "Peer review plays a

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Congress Weighs Action to Ease Helium Crisis

By Michael Lucibella

In the absence of Congressional action, the United States is facing a "Helium Cliff," resulting in an acute helium shortage and price spike even more dramatic than the current supply problems that are seriously impacting researchers, industry and clowns. Proposed legislation would prevent the worst disruptions in the market, but helium prices are almost certainly going to jump substantially by the end of the year.

The United States is the largest single supplier of helium in the world, but it's authorized to keep selling it for only a few more months. In addition, the low cost of crude helium from the federal government has led to over-consumption resulting in supply shortages.

"The pricing for the helium is not correct. The helium is being priced well below what the demand reflects," said Jodi Lieberman, senior government relations specialist at APS. "It's essentially underpriced and has been for many years."

In February, Congressman Doc Hastings (R-Wash.) introduced a bill in the House of Representatives to let the Bureau of Land Management's (BLM) National Helium Reserve continue to sell its helium for years at a cost that will more closely reflect market rates. A similar bill is likely to be introduced soon in the Senate. It should prevent current shortages from worsening, but it is not likely to add excess capac-

HELIUM continued on page 6

Congressman is Charter Member of New APS Section

The newly formed Mid-Atlantic Section of the APS got a big boost when physicist and Congressman Rush Holt (D-NJ) joined its ranks. In a letter he wrote to the section (text on page 3), Holt congratulated its founding members and emphasized the dual role that scientists have to advance knowledge and weigh in on important national issues.

The section's past-Chair, Charles Clark of NIST, first reached out to Holt's office during the 2012 campaign. At the time, Holt was the only PhD physicist serving in Congress.

"To get him to join this newly founded section is a very great thing for us," Clark said. "On the national scene, he's probably one of the best known physicists in the country." Clark added that he was excited that the letter came in time to be included in the section's first newsletter.

Congressman Rush Holt (D-NJ)

"I thought it would be a very great thing for the APS as a whole to hear, reiterated by a person of his stature, the value that he thinks our Society offers society at large," Clark said.

Holt represents central New Jersey. Before winning office, he was Assistant Director of the Princeton Plasma Physics Laboratory and a professor of physics at Swarthmore College before that. He is a Fellow of APS.

Holt used several sections in the letter in recent testimony before a subcommittee of the House Committee on Oversight and Government Reform. His presentation to the Subcommittee on Federal Work Force, U.S. Postal Service and the Census highlighted how important it is for scientists to travel to conferences and expressed his opposition to new restrictions on travel for federal workers.

The Mid-Atlantic Section incorporates physicists who live or work in Delaware, Maryland, New Jersey, Pennsylvania, Washington DC, and West Virginia. It officially formed in the fall of 2012 and is planning to hold its first elections later in 2013 and its first meeting at Penn State in 2014. The section's organizers also held a reception at the APS March Meeting in Baltimore as a way to attract more local members.

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What's in the Box?

Photo by Gene Sprouse

Answer: a ceremonial gavel, presented by APS Executive Officer Kate Kirby (left) at the February Executive Board meeting to Bob Byer of Stanford, in commemoration of the five Board meetings and two Council meetings that he chaired, among his many other duties as APS President in 2012.

Members in the Media

"There are many things you can learn [from the ISS]...surprising things."

***Samuel C. C. Ting**, the Massachusetts Institute of Technology, on his experiment, the Alpha Magnetic Spectrometer, on the International Space Station,* The Globe and Mail*, February 17, 2013.*

"If you had cosmic-ray eyes the sky would look very boring, because cosmic rays come from all directions."

***Stefan Funk**, SLAC National Accelerator Laboratory, on his discovery of the supernova origins of cosmic rays,* Time Magazine*, February 19, 2013.*

"As we work to ensure oversight on travel expenditures, we also should work to preserve the many benefits of appropriate travel, which can promote collaboration and innovation…As a scientist, I know firsthand how important scientific conferences and meetings are…The informal conversations, as well as the formal presentations and poster sessions that go into a conference among scientists from different institutions, lead to new collaborations that have the promise of new discoveries. These are not fancy junkets."

***Rush Holt**, House of Representatives, on impact of travel restrictions on federal scientists,* The Washington Post*, February 27, 2013.*

"What we are advocating is the need to establish nuclear and other essentially zero carbon options. We have to understand, what does it cost?"

***Ernest Moniz**, MIT, speaking to Washington's World Affairs Council before being nominated as Energy Secretary,* All Things Considered*, March 4, 2013.*

"Our issue is that Europe and Asia are contemplating or have made $10 billion investments in particle physics…How we compete is a problem for us."

***Jim Siegrist**, Lawrence Berkeley National Laboratory,*The New York Times*, March 5, 2013.*

"What most of us are motivated by is to find out something new, not just to measure some number to more accurate precision…up till now, there's no new stuff that's obvious."

***Robert Cousins**, University of California, Los Angeles, on his research at the LHC,* The Los Angeles Times*, March 6, 2013.*

"He has always been very inventive in thinking of new ideas extending and going beyond the standard model of particle physics."

***Edward Witten**, the Institute for Advanced Study, on Paul Frampton, who has been convicted of drug smuggling in Argentina,* The New York Times Magazine*, March 10, 2013.*

"[If] 'I predicted a particle that's actually in the universe.' Wouldn't that be a rush? Much better than other ways of getting a lot of dopamine…That would bring an enormous sense of fulfillment, quite apart from the Nobel Prize."

***Paul Frampton**, University of North Carolina, describing his greatest dream,* The New York Times Magazine*, March 10, 2013.*

"It is very exciting to be here, and this year just has been quite exhilarating as a particle physicist!"

***Meenakshi Narain**, Brown University, after CERN confirmed that the particle discovered last July is in fact the Higgs Boson,* MSNBC.com*, March 14, 2013.*

"Clear evidence that the new particle is the Standard Model Higgs boson still would not complete our understanding of the universe…We still wouldn't understand why gravity is so weak, and we would have the mysteries of dark matter to confront. But it is satisfying to come a step closer to validating a 48-year-old theory."

***Patty McBride**, Fermilab,* Los Angeles Times*, March 14, 2013.*

"[The results] are magnificent and to me it is clear that we are dealing with a Higgs boson, though we still have a long way to go to know what kind of Higgs boson it is."

***Joe Incandela**, CERN,* The Washington Post*, March 14, 2013.*

This Month in Physics History

April 10, 1661: Hooke's pamphlet on capillary action

The 17th century scientist Robert Hooke is best known for the eponymous Hooke's Law and for his masterwork, *Micrographia*, a treatise detailing his observations of everyday objects under a microscope, complete with eye-popping illustrations. But his scientific interests were very diverse, and among his earliest work was a pamphlet on the phenomenon of capillary action.

Born on the Isle of Wight to a curate, Hooke was initially destined to become a minister, like his three brothers, but he suffered from bad headaches, which made studying difficult, and his parents abandoned his formal education. The young Robert loved the natural world and showed a proficiency for mechanical tinkering, building such devices as a working clock and a model of a ship with working guns. He also showed a gift for drawing. When his father died, the 13-year-old Hooke was apprenticed to the leading portrait painter of the age, Peter Lely.

frost beard detail

But Hooke complained that the oils and varnishes irritated his chest. Deciding the apprenticeship was a waste of time and money, he left to attend Westminster School, where he acquired mastery of ancient languages, learned to play the organ, experimented with flying machines, and is said to have mastered the first six books of Euclid's *Elements* in a week. He boarded with the headmaster, Richard Busby, who became Hooke's earliest mentor.

In 1653 Hooke became a chorister at Christ Church, Oxford, and found himself keeping company with some of the top British scientists of his day. He never earned a formal degree, but he worked briefly as a chemical assistant to Thomas Willis, and in 1658 he became assistant to Robert Boyle, applying his mechanical skills to the construction of an improved version of Boyle's air pump (*machina Boyleana*), and gaining a thorough mastery of chemistry and practical laboratory skills.

He also became fascinated by the challenge of keeping correct time on ships at sea–a key factor in the quest to accurately determine longitude. The pendulum clocks of the era couldn't adapt to the pitching of a ship, and he had the idea of using springs to control the balance wheel instead. His experiments were successful, and he went so far as to have attorneys draft a patent for his design of a spring-controlled clock, with an eye toward making his fortune. But when he learned more about the legal ramifications, he opted not to file the patent. Christiaan Huygens later published his own version of a balance spring mechanism in 1675.

Hooke had plenty of other scientific interests to keep him occupied, and a tight-knit group of colleagues concerned about preserving their research results. They resolved to found their own philosophical society. The first meeting of the Society for the Promoting of Physico-Mathematical Experimental Learning took place on November 28, 1660 in Gresham College, attended by a dozen scientists.

It was at just such a meeting that Hooke presented his very first scientific finding to his gathered colleagues on April 10, 1661, reading aloud from a short pamphlet demonstrating that the narrower the tube, the higher water would rise in it, due to what we now call capillary action.

In 1662, Hooke was appointed curator of experiments to what had now become the Royal Society, responsible for the experiments performed at its weekly meetings, although he received no payment initially for his services. He was elected as a Fellow of the Society in June 1663, and he was granted a small stipend the following year and made curator of experiments for life. In 1665 he was finally hired as a professor of geometry at Gresham College, giving him financial stability at last.

The publication of *Micrographia* that same year cemented his scientific reputation. Described in contemporary accounts as a "lean, bent and ugly man," Hooke was keenly sensitive to ridicule. So he did not take kindly to playwright Thomas Shadwell's *The Virtuoso*, which included a caricature of an experimental scientist clearly based on Hooke. "Damnd Doogs, Vindica me Deus, people almost pointed," Hooke huffed in his diary after attending a performance.

While largely overshadowed by his contemporary, Isaac Newton, Hooke was unsurpassed in his time as an inventor and designer of scientific instruments. He invented the compound microscope; a wheel barometer; and the universal joint found today in all motor vehicles (the "Hooke's joint"). He was among the first to grasp the importance of improving the resolution of astronomical instruments, and built the first reflecting telescope, using it to observe the rotation of Mars and note one of the earliest examples of a double star. And he was an accomplished architect, providing his services as a surveyor and designing many London buildings after the Great Fire of London.

In his later years, Hooke's health deteriorated, and he suffered from numerous symptoms of cardiovascular disease and diabetes: swollen legs, chest pains, dizziness, emaciation and blindness. He died on March 3, 1703.

Hooke's humble pamphlet on capillary action wasn't the last time the phenomenon was a subject of scientific interest. It's also behind the formation of so-called frost flowers (or ice ribbons), first noted by astronomer John Herschel while walking through the woods one winter morning.

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APSNEWS

Series II, Vol. 22, No. 4
April 2013

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, Email: 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.

Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: BUDGET

Sequestration

Across the board federal budget cuts, known as sequestration, took effect March 1. Defense discretionary accounts declined 7.3 percent and non-defense discretionary accounts, 5.9 percent. The Continuing Resolution, which has been funding federal programs at last fiscal year's levels, expires on March 27, requiring Congressional action to avoid a government shutdown.

On March 6, the House of Representatives passed legislation extending the CR to the September 30, the end of fiscal year 2013 (FY13). The House bill incorporates the sequestration and provides some limited reprogramming, but only for the Department of Defense.

On March 12, the Senate Appropriations Committee adopted legislation that maintains the sequestration but, to mitigate the sequester, provides some reprogramming for NIST and NASA along with modest funding changes for NSF and OSTP. The Senate bill maintains FY12 appropriated levels for the Department of Energy, NIH, and the Department of Defense. At press time, the Committee bill was still awaiting full Senate action.

Fiscal Year 2014 Presidential Budget Request

The President's Budget Request, legally mandated for delivery on the first Monday in February, was delayed because of the uncertainties in the baseline for the FY13 budget, created by the sequestration and uncertainties surrounding extension of the Continuing Resolution. The White House has signaled that it expects to submit the presidential budget on April 11. The budget request is expected to be lean with flat or marginally increased funding for science.

ISSUE: POPA

A POPA study committee charged with examining technical issues associated with long-term operation of nuclear reactors met in February for a two-day workshop, receiving information from industry, university and government laboratory experts, as well as from and the Nuclear Regulatory Commission. The committee expects to release its report later this year.

A study, jointly sponsored by APS and the Institute of Electrical and Electronics Engineers (IEEE), has completed a draft report on nuclear and radiological detection for the Department of Homeland Security's Domestic Nuclear Detection Office (DNDO). The report, currently under review, will be released later this year.

A two-day workshop devoted to potential U.S.-Russian agreements on non-strategic nuclear warheads and sponsored by the State Department in conjunction with APS and the Center for Strategic & International Studies (CSIS), took place in February. Participants included policy and technical experts from the United States, Russia, Turkey, Sweden, France and the United Kingdom.

A template for study proposals can be found online, along with a suggestion box for future POPA studies, by visiting:

http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm.

ISSUE: MEDIA UPDATE

Roll Call, a leading Capitol Hill newspaper, published Michael Lubell's column, "Lessons from the Cliffhanger" on Jan. 21. The piece noted that the Jan. 1 fiscal deal made sequestration more politically palatable by lowering reductions of defense and non-defense spending. On March 1, Lubell appeared on NPR's *Science Friday* program in a segment titled "Mapping the effects of the sequester on science." Lubell said the sequestration would have long-term, devastating effects on science.

The February edition of *Capitol Hill Quarterly*, published by the APS DC Office, featured an op-ed by U.S. Rep. Lamar Smith, chairman of the House Science, Space, and Technology Committee. In the piece, Smith notes the country should continue to support scientific research and STEM education, even in the face of tough fiscal times. He explained that research has given us innovations and business that stimulate economic growth in our nation.

Log on to the APS Public Affairs Web site (http://www.aps.org/policy) for more information.

Nominating Committee Gathers in College Park

Photo by Michael Lucibella

In the middle of February, the Nominating Committee met at APS headquarters in College Park to perform the important task of finding the best candidates to stand for election to several APS positions, including the Presidential Line. In the front row, left to right, are: Robert Cahn, Nora Berrah, Committee Chair Sally Dawson, and Susan Blessing. In the back row are, left to right: past Committee Chair Lars Bildsten, Committee Chair-elect Paul McEuen, APS past-President Robert Byer, and David Hammer.

Text of Rush Holt's Letter (see story on page 1)

Congratulations on forming the Mid-Atlantic Section of the American Physical Society. As a longtime member of APS who has spent much of my life in West Virginia, New Jersey, and the District of Columbia, I am pleased and honored to join you in the Mid-Atlantic Section as an original member.

I have spent my career as a professional scientist and now as a member of Congress, so I know firsthand how scientific research contributes to every American's quality of life. APS helps us to more completely understand nature and our universe, and it provides an avenue through which physicists from all around the world can converse about the advancement of physical concepts and ideas.

APS is first and foremost a national organization, and indeed, it usually makes sense to think of physics as being a collaborative endeavor. Many of the theoretical and experimental insights that have driven our field forward in recent years have been possible only through the collaboration of dozens, hundreds, or even thousands of physicists scattered across the globe.

But the fact remains that many insights are possible only because of close, personal interactions among scientists who see each other regularly: those who work at the same university, or who see each other at local conferences, or who stop by one another's houses for dinner and find themselves scribbling half-developed equations on the backs of pizza boxes. Proximity matters, in physics as in every other field (is collaborative productivity an inverse power law?), and I am hopeful that the Mid-Atlantic Section will strengthen these local connections that help make possible further scientific progress.

It is, I think, especially noteworthy that the Mid-Atlantic Section includes Washington, D.C. and thus the entire U.S. Congress. To state the obvious, your perspective is very badly needed on Capitol Hill. Right now Congress includes only two physicists (the other is Bill Foster of Illinois), and we need look no further than the phony debates about the scientific validity of climate change or evolution to understand that scientific thinking is far too rare in Congress today. The Mid-Atlantic APS section has the opportunity–and, I would suggest, the responsibility–to help bridge the gap between the scientific community and those who pass laws that affect it.

I hope that, at some point in the years to come, you'll take the relatively short trip to Capitol Hill to share your thoughts and concerns with your representative in Congress. You have important insights to share on climate change, renewable energy, nuclear security, and so many other issues facing our country today. And while you're in town, stop by my office to say hi!

Sincerely,

RushHolt
Member of Congress

Jack Sandweiss Looks Back on 25 Years at *PRL*

Ed. Note: *As Jack Sandweiss, the Donner Professor of Physics at Yale University, prepared to leave office after a quarter century as the senior editor of* Physical Review Letters*, he took time to reflect on his experiences in an interview with Michael Lucibella of* APS News.

Q: How has the journal changed in the 25 years you've been there?

A: It's grown a lot, but it hasn't changed in a fundamental sense. If anything, the standards have probably increased slightly. Our acceptance rate used to be something like 40%, and now it's a little under 30%. *PRL* has gotten bigger, but its basic philosophy hasn't changed. The other thing I would say about it is we've somewhat broadened the areas that we call physics. For example, when I started, something called soft matter physics (polymers, foams, gels, that kind of thing) did not have its own separate section but the subject grew in the physics research world quite a bit, and now we have a section on soft matter and other related things.

A couple of years ago we had a big effort to raise the standards because we thought the journal was just getting too big. We did actually succeed in raising the standards. We sent an email to all the authors and referees, had

meetings with the divisional associate editors and so on, and we made a more precise definition of what a paper should be if we wanted to publish it in *PRL*.

Q: What can you say you've contributed to the journals?

A: Mostly it's a sort of day-to-day thing. One of the things that I do is the handling of appeals. The paper comes in, editors send it through referees, referees make comments, editors read them, and they make a decision. An author who does not like the decision can appeal to the divisional associate editor, what we call the DAE. I'm the chairman of the DAEs, so that's also one of my activities. A lot of papers are perfectly good papers, but they're just not important enough to put in *PRL*.

What the journal should publish are the papers that you cannot afford to miss in your field. One of my colleagues became the dean of a graduate school, so he had to cut back on his research, but he still could read *PRL* every week and he didn't have a big thing that he missed. He had to do a lot of homework when he came back, but he knew the main things that happened in the field. And that's the test that we want to make of the papers.

When we have to hire new editors, I'm involved with deciding whom to hire. And I'm also involved with the general policy of the journals. The editor in chief is mainly involved with that, but I'm part of it. For example, some years ago when we went elec-

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Letters

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

Centrifuges, not Lasers, the Real Proliferation Danger

Regarding the January Back Page on "The Benefits and Risks of Laser Isotope Separation": It seems strange that you should pick on an inefficient method that had already been tried for years at Livermore. Centrifugal separation is much more efficient and is the reason we are worried about Iran's program.

In the 1970s, Livermore had a large program for isotope separation using copper lasers. At the same time, TRW had a large program using ion cyclotron acceleration of uranium in a magnetized plasma, based on the theory and impetus of John Dawson. It was headed by Don Arnush, who reported to Peter Staudhammer, and the theoretical group was headed by Burt Fried. I am the only survivor. The method made clever use of the fact that a minority species could be accelerated to much larger orbits than the majority species. The experiment was a success, and palpable quantities of U235 could be obtained. Nonetheless, the politicians canceled the program to protect Livermore's status as a national lab. (You can tell I'm incensed about this.)

Years later, the Dawson scheme was revived in several places for the purpose of making medical isotopes, but they all ran out of money. Most recently, Alfred Wong, after retiring from UCLA, formed the company Nonlinear Ion Dynamics LLC, in which he had a new Dawson Separation machine built with superconducting coils. I don't know what became of that. On Wong's website, I see that in 2011 he was working on "charged-fluid centrifuges for separation of large quantities of isotopes."

I wrote up a summary of the Dawson Separation project as a chapter entitled "The Double Helix: The Dawson Separation Process" in the book *From Fusion to Light Surfing, Lectures on Plasma Physics Honoring John M. Dawson* by Thomas Katsouleas (now Engineering Dean at Duke). This paper is No. 136 in my website below. As far as I know, I am the only one with copies of all the previously classified memos produced in the project.

It would be more fruitful to develop the Dawson scheme for medical isotopes rather than using lasers, which are more glamorous and more attractive to the ill-informed. Furthermore, one cannot discuss proliferation without emphasizing centrifuges.

Frank Chen
Los Angeles, CA

Nothing Wrong with Fewer Women Physicists

I was shocked by the quote from Kate Kirby in the February *APS News* in which she says, "Encouraging women to pursue physics is a top priority for us." If you believe that physicists "should" be 50% men, 50% women, and then try to achieve that goal by "encouraging" girls to pursue physics, you are deciding ahead of time what you believe the percentage should be, and then trying to make that happen. This would be the same as if you believed that physicists "should" be 100% men, 0% women, and then tried to achieve that goal by discouraging girls to pursue physics. It is morally wrong to believe that the percentage of physicists who are women should have any specific value. If you believe that in a perfect ideal world, physicists would be 50% men, 50% women, do you also believe that in a perfect ideal world, nurses, elementary school teachers, and secretaries would also be 50% men, 50% women? Nurses, elementary school teachers, and secretaries are 90% women, 10% men. Nobody thinks that's a problem. Nobody says we should encourage boys to enter those professions. If boys are less interested in those professions, what's wrong with that? If physicists are 80% men, 20% women, why would that be a problem? If girls are less interested in being physicists, what's wrong with that?

Jeffery Winkler
Hanford, CA

Solution to Pioneer Anomaly is Premature

Michael Lucibella's "Top Physics Newsmakers of 2012" in the February *APS News* listed the culprit for the Pioneer Anomaly as having been found. I think this is premature. Turyshev's paper dealt with only the Pioneer 10 (P10). Much of the data used to calculate the forces are less well known or are unsupported by other data. A lower anomaly occurred during the Saturn encounter of P11. Also, the P11 values were slightly different from the P10 data. The P10 data at the furthest distance flattened and increased which is inconsistent with a declining thermal cause. Although this increase is within error limits, several readings showed the trend. Turyshev et al.'s 2011 paper suggested the Pioneer anomaly may be Earth directed which is inconsistent with a declining thermal cause. The cosmological connection is unexplained by the thermal model. The solar and sidereal diurnal periodicities are unexplained by a thermal model. Anderson 2002 overreaches the uncertainty of the JPL's Horizons data. At the very least we should wait until Turyshev's model is compared to P11 data.

Although Turyshev's paper is probably the last possibility for traditional physics, a new physics cause may still be possible.

John C. Hodge
Flat Rock, NC

zero gravity

Schroedinger's Cat

Saying–"Curiosity killed the cat."
It's cruel, even if theoretical–
A cat, even if it's hypothetical,
Placed in a box with poison spray,
The switch, radioactive decay.
Perchance does that famous feline
Have lives beyond the fabled nine?
Does it twinkle in and out of being?
Where does it go when we're not seeing?
Perhaps that elusive creature purrs
In some alternate universe,
Or curls up in a superstring
Or some such insubstantial thing?
In its strange probabilistic state,
One peek inside will seal its fate.

Joan Braman

APS Creates Degree Demographics Site

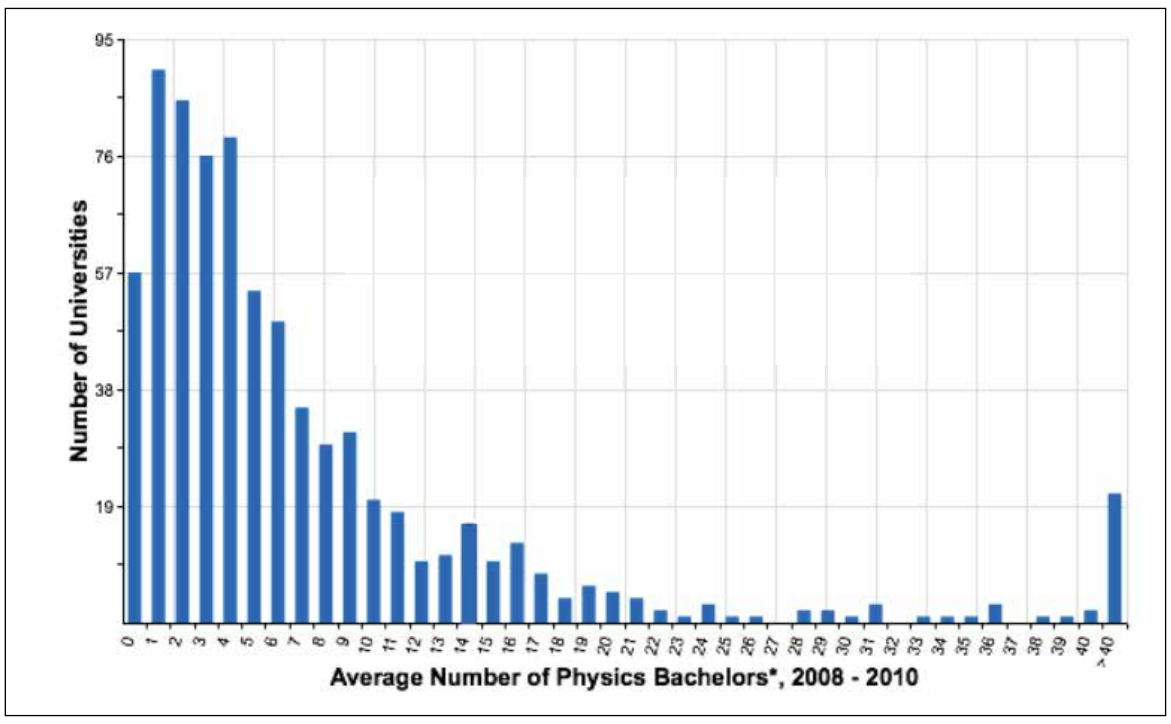
It didn't used to be easy for a physics department to gauge how well it compared to others in the number or diversity of its graduates. Now, with the new degree demographics site from APS, one can search every physics program in the US and see how many degrees each has produced and how it compares nationally to other physics degree-granting institutions.

This new website, at go.aps.org/degreecompare, is an outcome of the Doubling Initiative–a joint effort by APS, the American Association of Physics Teachers, and the Society of Physics Students to advocate doubling the number of bachelor degrees in physics to address critical national needs including K-12 education, economic competitiveness, energy, security, and an informed electorate.

In 2007, the APS Executive Board endorsed a statement calling for doubling the number of physics bachelors in the US. This action pre-dated calls by other organizations to increase the number of STEM (Science, Engineering, Mathematics, and Technology) majors in the US, such as the 2012 report "Engage to Excel" from the President's Council of Advisors on Science and Technology.

Recognizing the need to make full use of the talents of women and underrepresented minorities (URMs) to meet the demands of the growing US science and technology sector, the statement specifically noted that it was essential to increase the number of both women and URMs who major in physics. Without these individuals, the US will lack the diverse scientific workforce necessary to drive innovation and solve complex problems.

The new degree demographics website is designed to allow US institutions to see how they stack up nationally in terms of producing physics degrees and encouraging diversity among these degrees. The site features every institution that has granted a physics bachelor's, master's or doctoral degree during the three most recent years for which data are available from the Department of Education's National Center for Education Statistics (2011 data will be available on the site this summer).



The degree data used in the institutional comparison graphs are presented as 3-year averages and can be sorted by the type of degree. The raw data for each institution are also provided.

In addition to information on how one's institution compares in awarding physics degree to women and URMs, data are available on the percentage of physics degrees granted based on all degrees granted at the institution and all STEM degrees granted at the institution.

"We hope this site will allow universities to better understand where they stand, and how improvement can be made," said Theodore Hodapp, Director of Education and Diversity at the APS, "by observing their own department, and by looking at comparable institutions."

The APS Education & Diversity Department created the site, and will be improving its functionality going forward. Input from the physics community is welcome; feedback and suggestions should be sent to education@aps.org.

Education Corner

A column on educational programs and publications

Registration Open for 2013 Department Chairs Conference and Go the Distance: Distance Education and Online Learning in Physics Workshop

Physics Department Chairs Conference (May 30-31)
The American Physical Society and the American Association of Physics Teachers are pleased to jointly organize the 2013 Physics Department Chairs Conference, to be held on May 30 (evening) and 31 (full day) at the American Center for Physics in College Park, MD. This conference is one of a series of conferences that have been organized biennially for the past three decades. Topics of interest to chairs representing the full range of physics departments are planned for this event. The conference is held jointly with the Distance Education and Online Learning in Physics Workshop.

Distance Education and Online Learning Workshop (June 1-2)
Immediately following the Department Chairs Conference, the "Go the Distance" workshop on June 1-2 will provide participants a chance to discuss the opportunities and implications of distance education and online learning for the physics community. Topics will include:

- MOOCs (Massive Open Online Courses)
- Hybrid and Fully Online Courses
- The Flipped Classroom
- Assessment and Research
- Laboratories

Participants may register for either or both conferences at: http://go.aps.org/chairregistration

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

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

ALPhA's Laboratory Immersions Program Expands in 2013
During the summer of 2013, the Advanced Laboratory Physics Association (ALPhA) will be offering an expanded selection of 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 10 sites offering a total of 20 different experiments, many based on popular workshops at last summer's Conference on Laboratory Instruction Beyond the First Year of College.

For details, including topics and registration, please visit www.advlab.org.

APS Speakers Program features Physics Education Researchers
The APS Speakers Lists contain names, contact information, and talk titles of physicists who are willing to give talks on a variety of subjects. Advanced searches allow one to search specifically for physics education researchers (PER). Learn more at http://www.aps.org/programs/speakers/

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In March 1884, *Nature* reported that one Professor Schwalbe, at a meeting of the Physical Society in Berlin, had succeeded in producing his own ice flowers from withered and rotten twigs he'd brought with him to the conference from the Harz Mountains.

In 1914, a physicist at the National Bureau of Standards named William Coblentz observed frost flowers while strolling in Washington, DC's Rock Creek Park. When he observed his first frost flowers, he wanted to understand the physical mechanisms behind their formation. He cut off stems, inserted them in moist soil and test tubes, recorded how quickly water moved up the dry stems, and figured out how to grow ice ribbons in the lab. He conclusively demonstrated that the water that makes the ice comes from within the stem, rather than being deposited from moisture in the air, and that they formed due to capillary action.

INTERNATIONAL News

...from the APS Office of International Affairs

The Ibero-American Federation of Physical Societies (FEIASOFI)

J. Raul Grigera

With many scientific societies located in various countries around the world, we might ask ourselves, what is the purpose of establishing a new regional society such as the Federación Iberoamericana de Sociedades de Física (FEIASOFI)? To start with, FEIASOFI is not a pure regional association, in that it is composed of physical societies from both Latin America and Europe (Spain and Portugal). Its formation was based not only on scientific affairs, but also on the common culture that originally came from the Iberian peninsula after the discovery of America, and was amalgamated by the local traditions and later by the enormous contributions from immigrants all over the world. The main reason for the creation of a regional society such as FEIASOFI is exchange and cooperation–sharing experiences toward solving research problems, sharing of local facilities, and student exchanges.

In Latin America, two languages are dominant,[1] Spanish and Portuguese, and are close enough to be understood by almost everybody. This allows communication not only with colleagues and advanced students, who also speak English, but also at different educational levels. For instance, meetings can include lectures for the general public from almost any of the speakers.

Physics in Latin America appears early, and *briefly*, in history. One of the first recorded activities dates between 1828 and 1834 when Octavio Mossotti left his homeland of Italy for political reasons, and undertook a position as Professor at the recently established (in 1821) University of Buenos Aires. During his time in Buenos Aires, where he taught elementary physics, Mossotti began to work on ideas that led to the well known Clausius-Mossotti equation. When the political situation in Italy improved, Mossotti returned home. A historian of physics may track other similar cases, or could tell us about the first research institutes in Latin America. Nonetheless, after these early endeavors, many years elapsed until physics really grew in the region. Nowadays, physics departments and institutes are very active in teaching and research.

Contact between physicists in Latin America and foreign colleagues–mostly from Europe and North America–grew steadily. However, cooperation *within* the region started slowly. As the number of active physicists grew in Latin America, professional societies began to appear in many countries and the physics communities began to have more organic interactions. Frequent meetings were organized between two or more societies, which produced a better knowledge of the physics community of each country, sharing their experiences and helping to address common challenges.

After several years of informal contacts, in 1995 the Federación Latinoamericana de Sociedades de Física-FELASOFI (Latin-American Federation of Physical Societies) was formed with the aim of increasing the interaction among the physicists of the region, while maintaining the identity of the national physics associations. Soon after (in 1996), and due to the strong interactions between Latin American countries and Spain and Portugal, an agreement was signed between FELASOFI and the physical societies of Spain and Portugal to constitute the Unión Iberoamericana de Sociedades de Física-UISF (Latin American Union of Federation of Physical Societies). The final statutes were fixed in 2005 where it was decided to change the name to Federación Iberoamericana de Sociedades de Física-FEIASOFI (Ibero-American Federation of Physical Societies).

International collaboration among FEIASOFI countries allows support for research across multiple sub-disciplines. Here, the situation is quite different for developing countries. For example, in developed countries, one can find almost any type of scientific equipment that one could need under one roof. However, the lack of such equipment in developing countries has produced an overabundance of theoretical research over experimental. Thus, programs that permit the mobility and exchange of researchers to perform specific experiments are extremely important. Enabling collaborations between different regions/countries that share common cultures can be beneficial. This has to be undertaken with care, however, for any particular country. There are large differences between countries, and hence, one of the strengths of FEIASOFI is to encourage and to facilitate cooperation among diverse organizations with common goals of spreading knowledge, sharing facilities, and helping scientists in different ways.

One of the first actions of FELASOFI was to publish the *Revista Iberoamericana de Física* (*Ibero-American Physics Journal*), which publishes articles in Spanish and Portuguese on classical and new topics. One audience for the journal is high school teachers, who can update their physics knowledge and lessons to include hot new topics, helping stimulate their students to go deeper in their physics studies.

Since its establishment, FEIASOFI has also supported the Physics Olympiads, which are geared towards pre-university students. These competitions help to generate an interest in physics, which is critical for attracting students to pursue physics degrees during their university studies. The Federation cooperates in different aspects with the organizing committees.

While excellent international meetings are taking place around the world, it is also important to encourage participation in regional meetings. We have to bear in mind that international travel requires resources that, unfortunately, many excellent scientists do not have. At the same time, the participation of scientists in local meetings of other countries can sometimes have difficulties for political reasons. Regional meetings can provide an opportunity to overcome these obstacles. FEIASOFI's endorsement of international meetings have, in some cases, strengthened scientists' ability to attend.

But these activities are not enough; the mission of FEIASOFI is to go beyond promoting meetings. With co-operation among its members, it must search for activities that can improve the scientific capacity of its member countries. The search for such activities, as well as the funding to support them, however, is not simple. Many technical and scientific problems have to be solved in different countries–identifying topics for collaboration requires harmonizing priorities, opportunities, and common interest across the field of physics. Metrology, for example, has come to be an important subject among countries, given its relevance to economic and public health issues. Resources have been assigned by the Brazil government for the project Ibero-American Physical Societies and the Dissemination of Metrology. The implementation for the project is now one of the main activities of FEIASOFI.

The above gives some of the history of science in Latin America, and recent activities of the newly formed scientific Federation, FEIASOFI. The Federation is still young, but we have confidence that in a relatively short time, its relevance will contribute to the development of physics activities of its members, as well as to the welfare of our collective population.

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1. Other official languages are Guarani (Paraguay-bilingual country-Spanish and Guaraní), English (Grenada), French (Haiti) and Dutch (Suriname).

Science Summitry

Photo by Florence Haseltine

Erstwhile MIT colleagues Ernest J. Moniz (right) and Subra Suresh (left) got together for a chat at an event in February hosted by the AAAS. President Obama has nominated Moniz, who is a professor of physics at MIT, to be the next Secretary of Energy, and, as *APS News* goes to press, he is awaiting Senate confirmation. During the Clinton administration, Moniz served as Associate Director for Science at OSTP, and also as Under Secretary of Energy. Suresh stepped down from his post as Director of NSF in March to assume the presidency of Carnegie Mellon University in Pittsburgh.

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angle, and their implications on future research into CP violation and beyond. Florencia Canelli of ETH Zurich will present some of the latest results of CERN's Large Hadron Collider. Tim Tait of the University of California, Irvine will talk about what particle physicists have to look forward to now that the Higgs Boson has been discovered. Also in Monday Morning's plenary session (P1), John Preskill from Caltech and Deborah Jin of NIST will present their research at the frontier of quantum computing, entanglement and quantum optics.

The Shores of Stability

Physicists in the 1960s predicted an "island of stability" for super-heavy elements with long lasting half-lives, theoretically centered around element 126. None have been synthesized so far, and whether they actually exist it is one of the persisting unsolved mysteries of nuclear physics. Jacklyn Gates of the Lawrence Berkeley National Laboratory will review the search for these elusive elements, as accelerators have managed to create heavy nuclei that lap at the shores of these so-called islands of stability. (Q3.03)

Renewable Energy by 2050

The future of renewable energy seems bright. Trieu Mai from the National Renewable Energy Laboratory and his team have recently concluded a study looking at the opportunities and obstacles for switching the United States electricity supply over to 80 percent renewable energy by 2050. The possibility is there, but it would take a concerted effort to make it happen. (H6.02)

Dating the Oceans

The new Atom Trap Trace Analysis for radio-krypton dating has started to transform Earth scientists' understanding of how the planet's hydrosphere behaves. It has already been used to map the evolution of the Nubian Aquifer of Africa, the Great Artesian Basin of Australia and the Guarani Aquifer of South America and the circulation of water in the deep oceans. In addition, the team from Argonne will present results that explore its uses to date ancient ice core samples. (J10.08)

Irradiating the Oceans

Ionizing radiation from space is ubiquitous, but the Earth's atmosphere does a good job of shielding its inhabitants from the dangers of cosmic rays–at least, most of the time. Some researchers have suggested that major space radiation events, like huge solar flares or gamma ray bursts, might have had an influence on some of the major extinctions throughout terrestrial history. Brian Thomas from Washburn University delves into this possibility, and shares some of his recent work looking at what happens to Earth's oceans when one of these cosmic events occurs. (X8.01)

New Gravitational Wave Detector

Though gravitational waves haven't yet been detected, physicists are already developing the next generation of detectors. Andrew Geraci from the University of Nevada in Reno and his team have devised a detector using sensors suspended by lasers in an optical cavity. Theoretically, the device should be an order of magnitude more sensitive to high frequency gravitational waves than any of the current designs, in a device that can fit on a tabletop. (L10.08)

The "Flame Challenge" Winner Speaks

Ben Ames from the University of Innsbruck won actor Alan Alda's "Flame Challenge" last year. The contest asked people to explain what fire is in a way that's both scientifically accurate, and understandable to the general public. Ames will talk about why engaging the public about science is important, what elements make for effective communication and what falls flat. (D5.03)

Science as Diplomacy

Science is an important diplomatic tool that can encourage international collaboration, trade and understanding. E. William Colglazier, the science and technology adviser to the U.S. Secretary of State, will explain how science diplomacy works, and how progress can continue to be made. (H7.03)

Dark Matter at Last…?

For months a mysterious 130 GeV gamma ray signal from the center of the galaxy has been hinting at the possible presence of dark matter. However, questions abound about whether the Fermi Telescope is seeing an artifact in the data or a real signal and what that signal actually means. Elliott Bloom from SLAC, whose team has been working on the data, will present the latest results on the signal, and what might be producing it. (J14.01)

HELIUM continued from page 1

ity to the global helium market.

The reserve dates back to the 1920s. It was established to stockpile helium to loft the army's fleet of dirigibles. In the 1960s the reserve purchased another large supply of helium with the expectation that demand would increase.

That demand never materialized, and left the reserve $1.4 billion in debt. In 1996 Congress froze the reserve's debt, declared that it was no longer necessary to maintain a strategic reserve of the gas, and would start selling down its 900 billion liters of gas.

The '96 legislation set the price of the reserve's helium to pay off the reserve's debt by 2015, not to reflect market conditions. At the time, the market price of helium was much lower than the price set by the government, so it was expected that the government would be the supplier of last resort.

However since then, the demand for helium in electronics manufacturing, industry and research has increased dramatically, while the government's price has not, resulting in shortages. Right now, the federal government supplies about 40 percent of the helium nationally and 30 percent globally. A study by the National Research Council in 2010, (and reflected in the bill introduced in the House) recommended continuing to sell helium at market rates, even after the loss has been recouped. Once only 85 billion liters remain, likely around 2020, the BLM would stop selling the helium except to the federal government itself and recipients of federal research grants.

For all consumers of helium, it will cost more to buy helium, but the question is how much. If no legislation is passed, the price of helium will skyrocket because of a dramatic reduction in supply, and shortages will likely become even more acute. If legislation is passed allowing the BLM to continue to sell helium after it pays off its debt, the price will be refigured to more accurately reflect its higher market prices.

"It's clear that the price of BLM crude [helium] is going to go up," said Omar Vargas, the director of governmental relations at Praxair, a leading helium supplier.

However the price is not likely to rise high enough to attract many if any new vendors to the market.

"The House bill will not result in additional helium...to come to market," Vargas said. "Helium is a contaminant of natural gas… they are not driven by the economics of helium in their decisions."

Helium is extracted along with natural gas. Though production of natural gas has increased dramatically in recent years because of advancements in "fracking," helium can't be isolated from that process, and escapes through the porous ground into the atmosphere.

There are a few companies around the world hoping to enter the market as helium suppliers. However, construction at the new plants in Algeria, Qatar and Russia has been delayed, and won't be online for some time.

"There isn't any more incentive to develop more helium," said Moses Chan, a physicist at Penn State and co-author of the NRC study. "In the long run, the helium price has no place to go but up."

Already, the distortions in helium prices and subsequent shortages have made it difficult for researchers to access a reliable supply. Helium remains a liquid at temperatures lower than 4 Kelvin making it invaluable to cool superconductors and other low temperature experiments. The high cost of helium has eaten into scientists' grant money, while disruptions and delays in supply have hindered experiments reliant on the coolant.

"If there is no new replenishment of it coming in, I would have to warm [the experiment] up," Chan said. "All that calibration, my four to five months of work, would go down the drain."

Other cooling systems exist, but each has its drawbacks. Systems that recycle helium are available but expensive, costing $100,000 extra or more. Liquid nitrogen dips down only to 77 Kelvin, too warm for many low temperature experiments. Mechanical refrigerators, which use more moving parts, vibrate as they cool, which can also throw off sensitive experiments.

Rachael Floyd, the sales manager at Janis Research Company, a supplier of cryogenics equipment, said that she's already seen changes in the way researchers are buying equipment, and that will likely continue.

"If they are having a hard time getting liquid helium, they will have to outlay a lot more capital in the beginning," Floyd said. "Instead of spending a lot of money on liquid helium as time goes on, they're spending it upfront on a refrigerator."

Doctors who rely on helium to run MRI machines have had to invest in expensive recycling systems to ensure a more reliable supply. Helium is also widely used by industry in microchip manufacturing and welding.

Researchers using federal grants are allowed to participate in the government's "In-Kind" purchasing program. It prioritizes federal grant recipients, and sells them helium at a lower price. The federal government does not sell direct to consumers, but sells to distributors who then resell the helium at the two price tiers.

Some researchers, including Sam Aronson, APS's vice-President and former Director of Brookhaven National Laboratory, have charged that the distributors are not fully prioritizing federal grant recipients, instead selling first to commercial consumers at the higher price.

The Bureau of Land Management and the distributors deny this is happening, but in testimony before the House Committee on Natural Resources, Aronson stated "... small researchers reliant on federal research grants continue to be subject to severe supply constraints and price shocks which their research grants cannot accommodate....I also note that some large federal users are having their allocations cut back."

Historically, helium legislation has enjoyed bipartisan support, and Congress is likely to pass some version of the bill this year. Both bills permit the reserve to continue to sell helium past the date it breaks even. The version introduced in the House auctions off an amount of helium to distributors every six months. The Senate has not yet released its version of the bill. Last year, proposed legislation in the Senate would have collected information about the market value of the helium and sold it at similar prices.

Vargas from Praxair said that most distributors prefer the Senate's version because of concerns over continued disruptions in supply. It's possible that too much or too little would be auctioned off at any given time, resulting in shortages and surpluses and big swings in price over the year.

"That bill proposal…will inject considerable uncertainty into the supply chain, and at the end of the day that will affect jobs," Vargas said. "It doesn't take into consideration the very complicated mechanics of the helium market."

ANNOUNCEMENTS

OSTP continued from page 1

crucial role in the advancement of science, and publishers' contributions carry significant costs."

After the announcement, a wide range of groups, including publishers, libraries and open-access advocates, often with very different positions, have similarly supported the memorandum. Publishers have opposed many past open-access efforts because of the potential loss of revenue from libraries canceling journal subscriptions once their content is free.

The Scholarly Publishing and Academic Resources Coalition (SPARC), which has been pushing for the adoption of broader open access policies, hailed the announcement, calling it "a watershed moment," and adding that the directive "will accelerate scientific discovery, improve education, and empower entrepreneurs to translate research into commercial ventures and jobs."

The Association of American Publishers, which has in the past been sharply critical of legislation and proposals mandating open access, also supports the OSTP's directive.

"We've taken a fairly optimistic and forward-looking view of it," said Allan Adler, the vice president for legal and government affairs at AAP. "Of course, there is a lot that depends on how it's read and implemented by individual agencies."

Major commercial publishers Elsevier and Springer have similarly issued statements saying they are "encouraged" by the OSTP memorandum and that it was "a very reasonable place to start."

The reason that so many groups with opposing views have been supportive of the directive may be that so far it is only a framework. The memo sets up a goal that 12 months after research using federal funds is published, it's made available to anyone for free, but it does not specifically say how or in what form. Publishers have said that they prefer working with the agencies to come up with a policy, rather than having a universal system for all sciences legislated by Congress.

"We've always had opposition to this idea of government mandates," Adler said. "This is more flexible in the sense that it does propose a 12 month embargo period, but as a guideline."

One of the biggest questions is whether the NSF and other science agencies would set up their own centralized databases to store research papers, akin to what the National Institutes of Health did in 2008, when it imposed a requirement that all research done with NIH funding would have to be made available in its open access database PubMed Central within 12 months of publication, building on a voluntary system in place since 2004.

The mandate was controversial when first announced.

"I have been totally opposed to PubMed Central since its inception," said Martin Frank, Executive Director of the American Physiological Society. He estimated that since 2008, his society has seen about a 15 percent reduction in downloads and a reduction of about 2 percent in subscriptions. Because of the economic downturn, however, it is difficult to ascribe that solely to PubMed Central.

Frank added that because of the reduced traffic to their websites, they've lost some ad revenue. *Physical Review* does not host advertising on its website, but Serene said that he would prefer to see the agencies set up a system that links to publisher websites, rather than hosting the papers themselves.

"What we would least like to see happen is the agencies run large archives," Serene said. "It's not easy or inexpensive to build repositories that work well…you may get archives that are not as good as they could be, or as good as already exist."

The memorandum states that repositories could be run by either the federal government or "scholarly and professional associations, publishers and libraries."

APS has a long history of open access initiatives, including allowing unrestricted posting of preprints and author's final versions of published papers. It publishes three open-access journals: *Physical Review X, Physical Review Special Topics - Accelerators and Beams* and *Physical Review Special Topics - Physics Education Research*. In addition, author-pays open access has been available for all other APS journals since 2006, and APS makes all of its publications and archives freely available to any U.S. public or high-school library.

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tronic, I was very active in helping to do that because I think it was a very good thing and I was part of the small group that hired the first head of our technical information division.

Q: How did you first come to* PRL*?

A: I always read it, and we published in it, so I knew about the journal perfectly well. And my colleague here at Yale, Robert Adair, had been the editor. He knew me and actually recommended me. There was a period when they didn't have any outside editor, they only had the in-house editors, and things didn't go so well. They needed that sort of stabilizing and professional view from the field. Adair recommended me, and the APS President, I think it was Val Fitch at the time, called me and asked if I would do it I thought about it and I said I have a fair amount of interest in broad areas of physics, apart from my own research, so I said I would do it. Once I got into it, I got into it. It's really quite a wonderful journal. We try hard to maintain it.

Q: Looking to the future, is it in danger of losing its premier position to Science ***or*** Nature?

A: I think it's changing. *Science* and *Nature* had more established "points" because they have a tremendous history. But they cover all of science. You get one or two [physics] papers there maybe a week. *PRL* publishes 70 or 80 papers a week. *Science* was always important, but it was so small it really didn't have a big effect.

Nature, recently, has started what we loosely call "Baby Natures ": *Nature Condensed Matter, Nature Photonics*, *Nature* everything, there's a whole bunch of them. Those are new journals, they don't really have the history of the real old *Nature*, and in some ways we don't think that their quality is quite so optimal, but they do have the cachet of having the title *Nature*, so we are concerned that we might be losing good papers to them.

We are trying to do things to make *PRL* have more visibility. APS started a website called Physics to highlight research published in our journals. It publishes "Viewpoints," which are written by people in the field, but not the author of the paper. It's quite a feather in your cap to get a "Viewpoint" written on a paper that you published in *PRL*. We also have other things called "Synopses," which are short pieces written by the editors themselves on interesting papers, and in the journal we added a feature called "Suggestions."

Q: What kind of characteristics do you think your successor should have?

A: I think he or she should be interested in the journal and have a breadth of interest in a range of physics. That's important because the journal covers lots of different things. An interest in the publication world, publications, referees, adjudicating problems and so on, that's something one should have an interest in and want to do. I write a lot of letters. For all of the papers I accept or reject, usually reject, I write a long letter to the person and explain that their thoughts were considered and they were evaluated, in perhaps not quite the way that they would have liked, but with consideration for their point of view. You have to write reasonably well, otherwise you could create a lot of people angry with the journal, which is not a good thing to do.

Q: Are you optimistic about the future of the journal?

A: Oh yes, I'm very optimistic. The reason why such journals are important is that there's a huge array of publications in physics. If you look at the ArXiv for example, in your own particular area, where you know the people well and the work well, you can perhaps pick up things that you should look at. But the minute you go the slightest bit away from that, you're overwhelmed with a huge number of papers you don't know what to do with. If you look at *PRL*, you know that these papers have been selected and reviewed and refereed, experts don't think there's anything wrong with them and they're credible and they're something worth knowing. That's a huge value to the reader and to the science community.

Another thing that is on the horizon that I think shouldn't really be for physics, is "Open Access." The driver in open access is the medical profession. If someone does a big test on some new drug, anybody can, in some sense, get an idea what that showed. I never yet have found a person in my everyday work that's dying to know the next article in *Phys Rev Letters*. It is in some sense a specialized addiction for physicists. I don't think that there is any real need for open access in physics, but nevertheless the idea has caught on and there are people who have religious ideals about it, but many of them don't actually realize that publishing a refereed journal costs money. You have to pay editors, you have to have a system, and you have to have a whole technology operation working. In a sense, open access doesn't make it free, it means, "Who will pay?" The main thing, which is the only way that it'll work, is if the author pays. That of course depends on the author's income, which usually comes from some grant. I think it's better to keep it the way it is, for us anyway. That is of course a journal-wide problem, and I take part in the discussions on it, but in the end it'll be the APS management that decides what to do with it, the editor in chief and the treasurer/publisher and so on. But I imagine that for a long time we will try to keep our library subscription policy as the main means of supporting the journals.

The Back Page

Direct Instruction rocks: Or does it?

by Richard Hake

David Klahr[1], in his provocative Back Page essay in the December *APS News* "Inquiry Science rocks: Or does it?" makes three points in his introduction:

1. "the relative effectiveness of different types of instructional 'approaches' is not always investigated with the same rigor that permeates all strong scientific disciplines–clear definitions, well-defined empirical procedures, and data-driven conclusions";
2. "for many aspects of science instruction, 'discovery learning' is often a less effective way to teach than a direct, didactic, and explicit type of instruction"; and
3. some in the physics education community may regard point (2) as "a foolhardy heresy, while for others it may be a dark secret that they have been reluctant to share with their colleagues."

I have previously stressed[2] the crucial importance of operational definitions in educational research and strongly agree with Klahr's first point. And considering the work of Chen & Klahr[3] and Klahr & Nigam[4], I would agree with point (2) IF "discovery learning" is defined as by Klahr & Nigam[4] as including near zero teacher guidance. However, as explained below, I would amend point (3) to read: "few physicists who read Klahr[1] carefully will regard point (2) as heresy, or a dark secret to be kept from their colleagues."

In support of point (2) Klahr describes a 1999 experiment by Chen & Klahr[3] which appears to demonstrate that for the instruction of seven-to-10-year-old students in the "control-of-variables strategy" (CVS), a direct-instruction-like pedagogy called "Training–Probe" produced better learning outcomes than a discovery learning–like method called "No Training–No Probe." The details of both methods are fully described by Chen & Klahr in their article.

In a later 2004 report, Klahr & Nigam[4] made what was later acknowledged by Klahr & Li[5] to have been a mistake by calling the "Training–Probe" method "Direct Instruction" (DI) and the "No Training–No Probe" method "Discovery Learning." This switch to loaded language led to a maelstrom of media misinterpretation (referenced by Klahr & Li[5]) in which it was often erroneously implied that Chen & Klahr[3] had shown that "direct instruction" in all its various forms was superior to "discovery learning" in all its various forms, in much the same way that Klahr's[1] Back Page essay could mislead some to think that "direct instruction" in all its various forms is superior to "inquiry science" in all its various forms.

Klahr & Li[5] wrote: "In hindsight, we may have muddied the interpretation of our findings by incorporating popular terminology like 'direct instruction' and 'discovery learning' into articles and public presentations of [Klahr & Nigam[4]]. Only when we tuned in to the recent political debate in California[2] about the permissible amounts of 'hands-on science' vs. 'direct instruction' .... did we become fully aware of how easy it is for someone to pick up a terminology, and imbue it with whatever meaning suits the purpose of an argument."

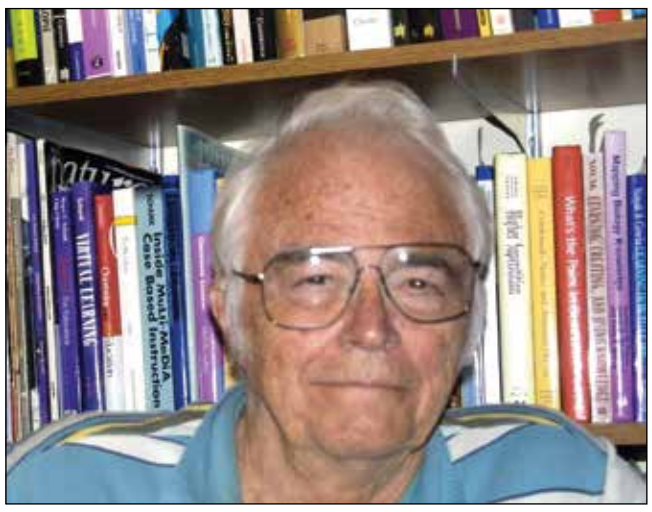
In his Back Page essay Klahr[1] attempts to better convey the meaning of Chen & Klahr's[3] "Training–Probe" and "No Training–No Probe" methods as follows:

The "Training–Probe" method is equated to "Type A" instruction in Klahr's[1] Table 1: hands on materials; teacher designed experiment; probe questions, explanations, and summary by teacher; no student execution of experiment or observation of outcomes.

The "No Training–No Probe" is equated to "Type C" in Klahr's[1] Table 1: hands on materials; student designed experiment; no probe questions, explanations, or summary by teacher; student execution of experiment and observation of outcomes.

But Klahr[1] correctly points out that the above descriptions must be supplemented by details if the methods are to be replicated, stating: "In our full scientific report...of course, each of the cell entries in the table was augmented by a detailed 'script' for how that component of the instruction was actually implemented, so that it could be replicated in other labs."

Considering that the Chen & Klahr[3] experiment concerns: (a) the process skill CVS, (b) seven-to–10-year-old students, and (c) the above descriptions of "Training–Probe" (TP) and "No Training–No Probe" (NTNP) methods, I think there is no reason for some in the physics education community to regard the apparent superiority of the TP over the NTNP in that study as surprising or grounds for heresy, as Klahr[1] suggests in point (3) of his introduction.



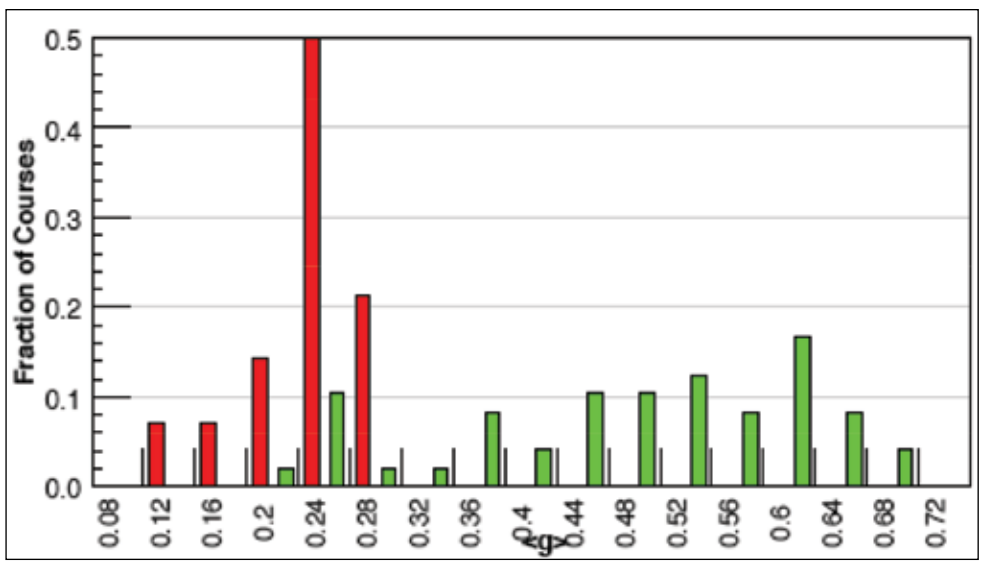


Fig. 1. Histogram of the average normalized gain <g>: dark (red) bars show the fraction of 14 "Traditional" (T) courses (N = 2084), and light (green) bars show the fraction of 48 "Interactive Engagement" (IE) courses (N = 4458), both within bins of width δ<g> = 0.04 centered on the <g> values shown.

Consistent with the above, as far as I know, physicists who read Klahr's Back Page essay carefully are not preparing to burn Klahr at the stake as a heretic. And–I think –for good reason: the apparent superiority of the direct-instruction–like TP over discovery-learning-like NTNP in the study of Chen & Klahr[3] has almost nothing to do to do with the demonstration by physics education researchers[6-11] that discovery-learning- like "interactive engagement" (IE) courses are superior to direct-instruction-like traditional (T) courses for promoting conceptual understanding of Newtonian mechanics in introductory physics courses–by about two standard deviations[8] in average normalized gain <g>.

For example, Fig. 1 shows a histogram[8] of the average normalized pre-to-post-test gain

<g> = (<%post> - <%pre>) / (100%–<%pre>)..(1)

= <%G>/max possible <%G>.....(2)

achieved by "Interactive Engagement" (IE) and "Traditional" (T) courses. In Eqs. 1 & 2 the angle brackets indicate class averages on concept inventories [Mechanics Diagnostic[6] (MD) or Force Concept Inventory[7] (FCI)–see the Wikipedia entry on "Concept Inventories" at http://bit.ly/dARkDY] of conceptual understanding of Newtonian Mechanics for introductory physics courses.

It should be noted that: (a) a high positive correlation coefficient r = + 0.91 was found[8] for post-test scores on the conceptual FCI test and the problem-solving Mechanics Baseline (MB) test[9]; and (b) references to 25 research reports of average normalized gains for IE and T courses consistent with ref. 8 are listed on page 12 of ref. 11.

This Fig.1 histogram showing the apparent superiority of discovery-learning-like IE courses over direct-instruction-like T courses is to be compared with the Fig. 1 histogram of Klahr, showing the–at first sight polar opposite–apparent superiority of direct-instruction-like "Type A" pedagogy over discovery-learning-like "Type C" pedagogy.

Here IE and T courses are operationally defined[8] as follows:

IE courses are those designed at least in part to promote conceptual understanding through the active engagement of students in heads-on (always) and hands-on (usually) activities that yield immediate feedback through discussion with peers and/or instructors ..... (A)

An elaboration of "A" has recently been given by Meltzer & Thornton[10].

T courses are defined as those reported by instructors to make little or no use of IE methods, relying primarily on passive-student lectures, recipe laboratories, and algorithmic problem examinations..... (B)

As indicated above, Klahr[1] cautions that it's necessary to provide a detailed "script" for how each instructional component of a method was actually implemented, so that it can be replicated in other labs. The "scripts" for IE courses are provided in ref. 8 since "A" is used as a proxy for the forty-eight IE courses (N = 4458) which are fully described in the companion paper "Interactive-engagement methods in introductory mechanics courses." I think the T course "scripts" are so invariant and so well known to physicists and to students who have taken traditional introductory physics courses, that the abbreviated description "B" is adequate.

In conclusion:

A. Klahr's[1] Fig. 1 histogram and the research of Chen & Klahr[3] and Klahr & Nigam[4] suggest that if one's goal is the enhancement of a process skill such as the "Control of Variables Strategy" (CVS) among elementary-school students then (s)he should probably consider utilizing Klahr's direct-instruction-like "Type A" pedagogy rather than discovery learning-like Type-C method with near zero teacher guidance.

B. The present Fig. 1 histogram taken from ref. 8, its corroboration by others listed in ref. 11, and the high positive correlation of post-test conceptual FCI and problem-solving MB tests, suggest that if one's goal is the enhancement of conceptual understanding and problem-solving ability among high-school or undergraduate students then (s)he should probably consider utilizing discovery-learning-like "Interactive Engagement" pedagogy rather than direct-instruction-like "Traditional" pedagogy.

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